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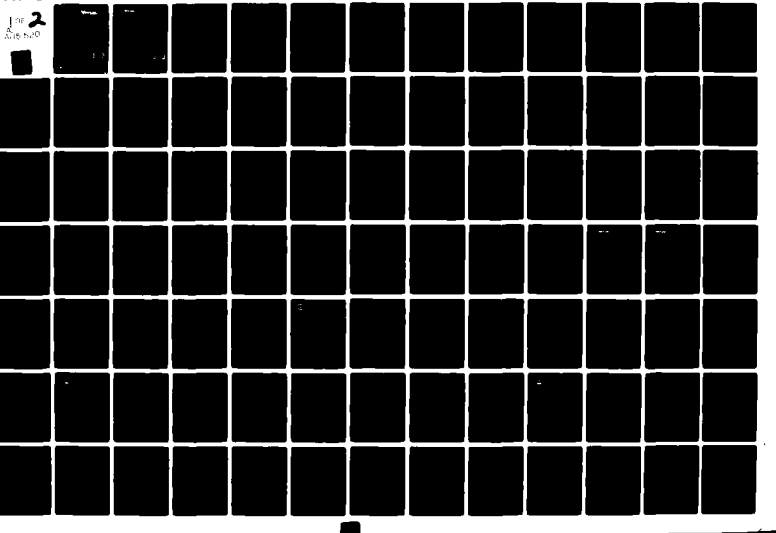

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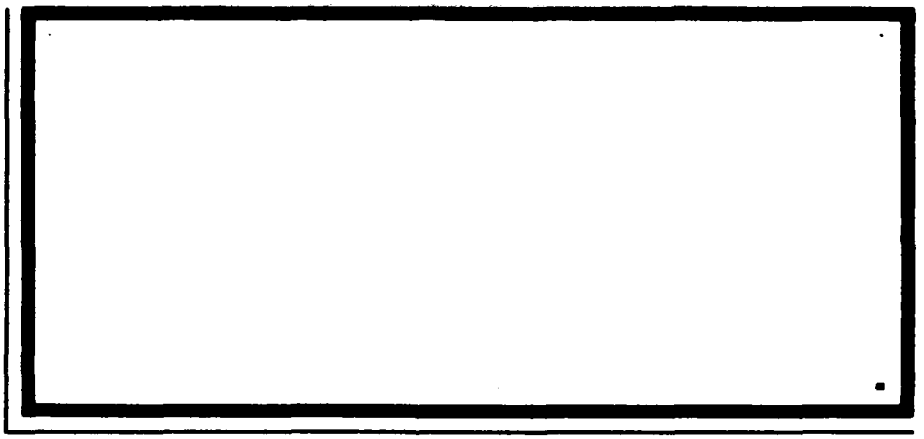

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Final Report

A LIMITED BIOLOGICAL RESOURCES EVALUATION OF 29 ALTERNATIVE HARBOR SITES ST. LOUIS HARBOR STUDY

Prepared for:

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
210 Tucker Boulevard, North
St. Louis, Missouri 63101

Contract No. DACW43-80-D-0025
Work Order No. 2

October 1980

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The objective of this study is to quantify and analyze certain parameters descriptive of the biological environment of 29 alternative sites along the Mississippi River selected by the U.S. Army Corps of Engineers, St. Louis District, as potential locations for a new harbor facility. The goal of this effort was to rank the sites in terms of their biological sensitivity; selec of the best harbor location will require more detailed studies.

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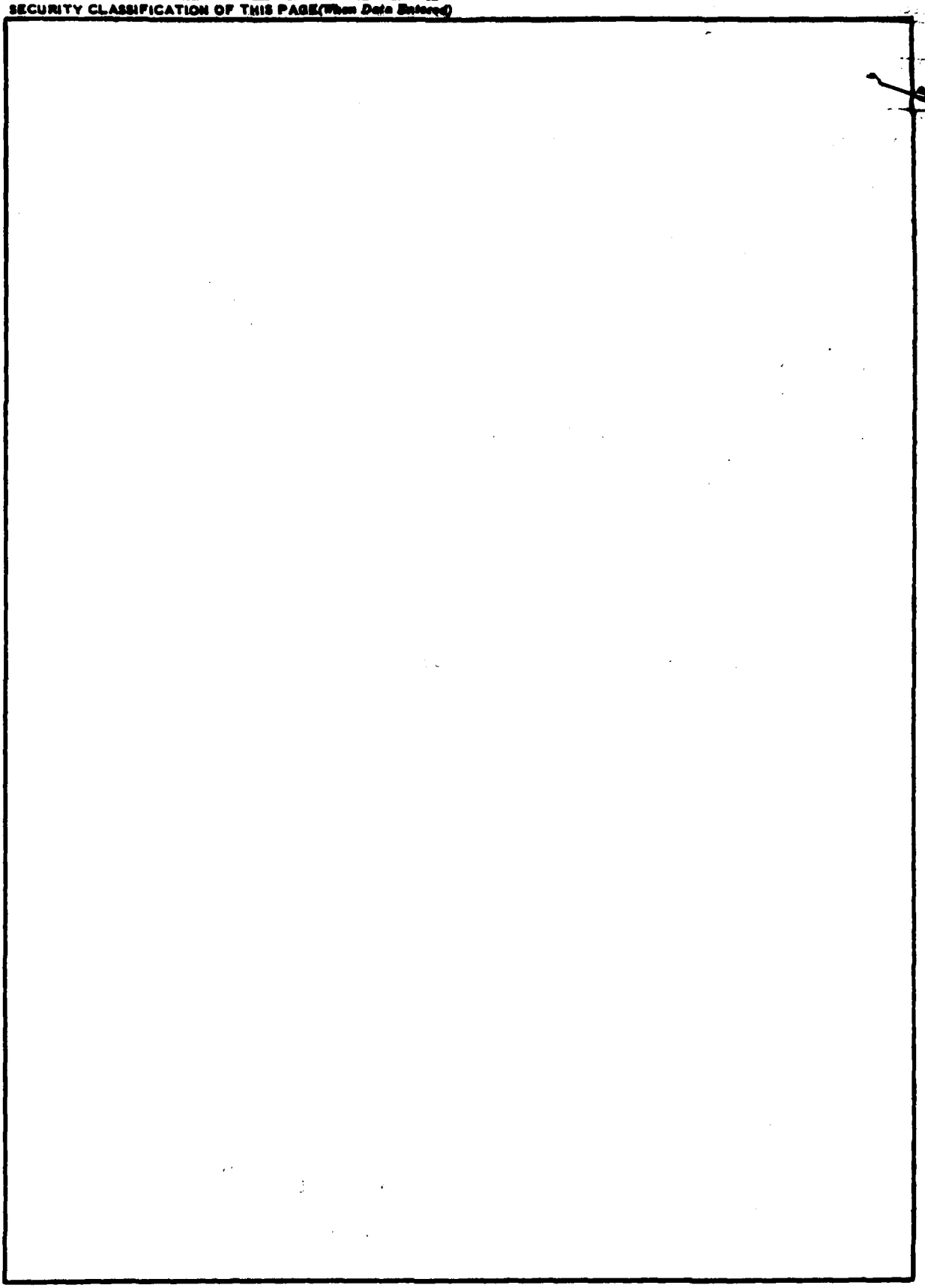

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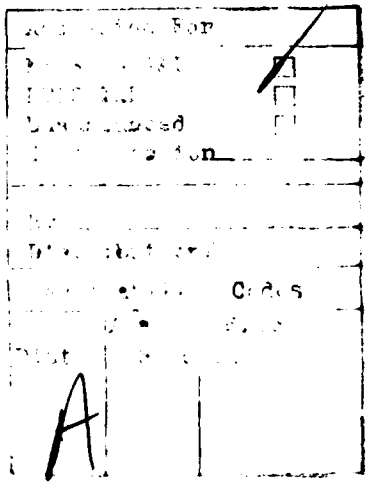

Approved by:

David A. Rudich
Director,
Environmental Planning Division

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1.0 EXECUTIVE SUMMARY

The purpose of this report is to provide a limited biological resources evaluation of 29 alternative harbor sites for the U.S. Army Corps of Engineers, St. Louis District as a part of the St. Louis Harbor Study. The area encompassed by the evaluation is the Mississippi River and its adjacent floodplain from River Mile 138.8 to 208.8, and includes portions of Illinois and Missouri.

The biological resources of each alternative site were compared by measuring several parameters with biological significance. The key parameters were terrestrial habitat, woody edge, aquatic habitat, shoreline development, and dredging. Measured parameter values were converted to a common 1-10 scale, and then weighted according to their relative importance using the ranked pairwise comparison method. The sum of the weighted parameter values for each site is the site's biological rating.

The biological rating was used to rank each site by its biological value or sensitivity; the larger the rating, the higher the ranking, and the more sensitive the site. This ranking is not intended to identify the best harbor sites or the sites that would suffer least from development. The ranking indicates only the relative biological value of the 29 sites, and is intended as a screening tool to select sites for in-depth analysis.

2.0 INTRODUCTION

2.1 OBJECTIVES

The objective of this study was to quantify and analyze certain parameters descriptive of the biological environment of 29 alternative sites along the Mississippi River selected by the U.S. Army Corps of Engineers, St. Louis District, as potential locations for a new harbor facility. The goal of this effort was to rank the sites in terms of their biological sensitivity; selection of the best harbor location will require more detailed studies.

2.2 BACKGROUND

This limited biological resources evaluation is part of the St. Louis Harbor Study, a dual-purpose effort resulting from two Congressional Resolutions. The first resolution, adopted in 1964, authorized a study of sedimentation in the St. Louis Harbor, with the purposes of determining both the causes and the most feasible means of reducing the condition. This study was needed because local areas within a 19-mile reach of the river were receiving sediment to the extent that access was prevented to some docks during low flow. The sediment deposition occurred in the areas outside the navigation channel. The harbor limits for the first resolution extended from River Mile 172 to 191 on the Mississippi River, above the mouth of the Ohio River.

The second resolution, adopted in 1971, authorized a study to explore the advisability of providing improved commercial harbor facilities at or in the vicinity of St. Louis. This resolution addressed local concerns relating to the fact that, while commercial activity on the river was increasing, a proportionate share was not occurring in the St. Louis area. After the second resolution, local interests petitioned the Army Corps of Engineers, St. Louis District, to expand the harbor limits so as to more closely define existing boundaries of port/harbor developments. The harbor limits were subsequently expanded to include both banks of the Mississippi River from River Mile 138.8 to 208.8.

As part of the St. Louis Harbor Study, 29 alternative harbor sites have been identified (Figure 1). Using a combination of various selection criteria and development opportunities, 16 of the study sites were originally identified by A.T. Kearney under contract with the East-West Gateway Coordinating Council. The Corps identified 13 additional sites based on a

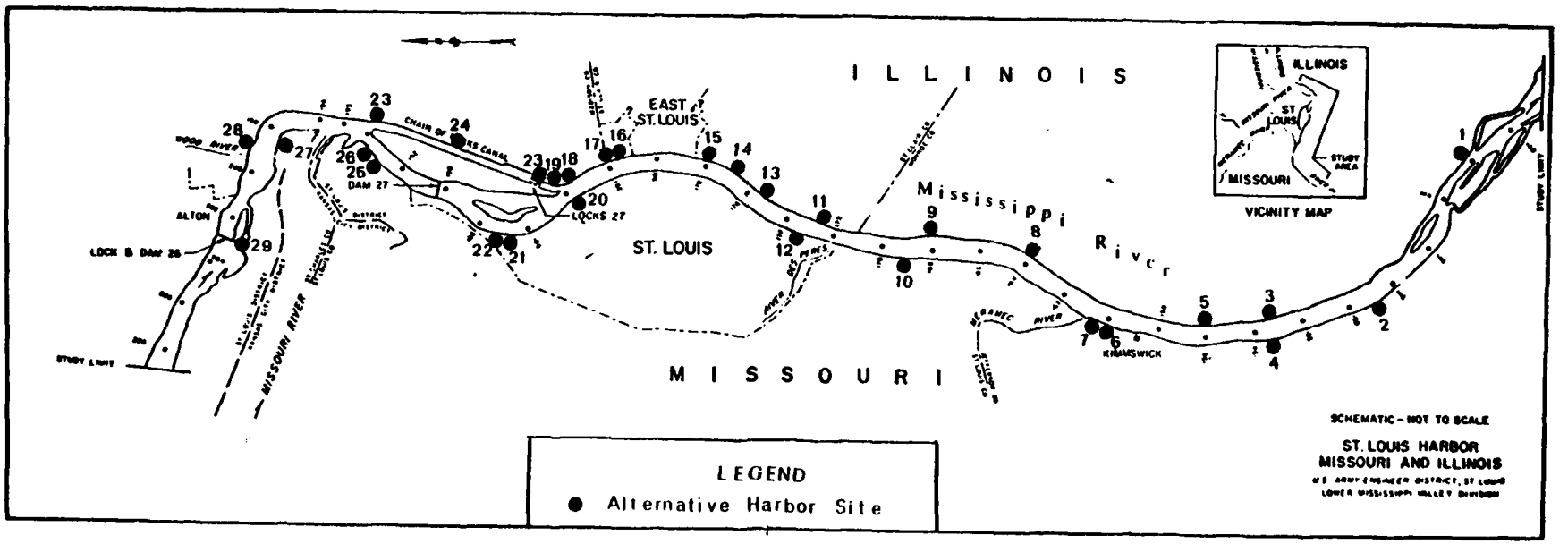

Figure 1. MAP OF STUDY AREA SHOWING LOCATIONS OF DOCKING SITES FOR 29 ALTERNATIVE HARBOR SITES

different set of criteria. The criteria used for selection of the 29 alternative harbor sites are given in Appendix A. Because the selection process used by the Corps and A. T. Kearney were independent, there is overlap between some of the 29 alternative harbor sites.

As it would be unfeasible to conduct an in-depth analysis of all 29 alternative harbor sites, the Corps has initiated preliminary socioeconomic and environmental screening studies. The purpose of the present report is to provide a limited biological resources evaluation as a partial basis for selecting sites which will undergo a more detailed investigation.

2.3 LOCATION AND DESCRIPTION OF STUDY AREA

The general study area is the Mississippi River and its adjacent flood plain, from bluff to bluff, extending between River Mile 138.8 and 208.8. As the Mississippi River forms the boundary between Missouri on the west and Illinois on the east, the study area includes parts of both of these states. The specific areas examined in this report are the 29 alternative harbor sites. The sites are numbered from 1 to 29 for identification, starting with the southernmost site and moving upriver (Figure 1).

At present the general study area includes woodlands, agricultural lands, and developed lands. Extensive areas of developed lands occur on one or both banks of the Mississippi River from River Mile 165 to 208.8, in the northern half of the project area. In the vicinity of St. Louis, from River Mile 176 to 184, most of the shoreline is developed commercially. The southern half of the study area (from River Mile 138.8 to 165) is generally less developed than the northern half. There, much of the west bank is vegetated with bottomland forest species; considerable acreage is also used for agriculture. Land use east of the Mississippi River from River Mile 138.8 to 165 is mostly agricultural. Sand and mudflats, brush lands, and wetlands are also represented in the study area; however, these habitats occupy relatively small areas.

The aquatic habitats represented in the study area along the mainstem of the Mississippi River include the main channel and main channel border, as well as areas influenced by the tailwaters of dams. Lock and Dam No. 26 (River Mile 203) and Dam No. 27 (River Mile 190) are located in the study area. Other significant aquatic habitats in the project area include backwaters, lakes and ponds, and tributaries.

2.4 COORDINATION ACTIVITIES

A scoping meeting was held by the St. Louis District, on 28 August 1979 for the purpose of determining the level of effort needed for the St. Louis Harbor Study and to introduce interested federal and state agencies to the study. The directional guidance resulting from this meeting was used to formulate a District Study proposal dated 14 September 1979. The study proposal, and the agency comments that followed, were used to develop the scope of work for the present investigation. The scope was then fowarded to outside agencies prior to awarding the contract.

Upon the initiation of this investigation, the first of three planned coordination meetings was held at the Corps headquarters in St. Louis on 1 July 1980. The purpose of this meeting was to bring all interested agencies up to date on the project, acquaint them with the methodology to be used, and solicit input from those agencies with biological expertise as to the value of certain general habitat parameters. The Corps, the U.S. Fish and Wildlife Service (FWS), the Illinois Department of Conservation (IDOC), and the Missouri Department of Conservation (MDOC) were selected to participate in evaluating the habitat types. An agenda of the meeting, a list of participants, and a copy of the follow-up letter are contained in Appendix B. At the second meeting, held on 26 September 1980, the participants submitted comments on the draft report. A list of attendees and a summary of the comments in letter form are also in Appendix B. The third meeting will be held approximately 20 days after submittal of the final report. At this time the final report will be reviewed.

3.0 METHODS

The methodology used in this investigation is similar to the environmental evaluation system developed by Battelle-Columbus for the Bureau of Reclamation, USDI (Dee, 1972). In this approach the biological sensitivity of a site was determined quantitatively by measuring a number of parameters which are expected to have biological significance. Measured parameter values were converted to a 1-10 scale and then multiplied by their respective parameter weights, which were previously determined using a ranked pairwise comparison technique. The sum of the products of scaled parameters and respective parameter weights provide a value which indicates the biological sensitivity of a site relative to other sites.

The major parameters used in this study were terrestrial habitat, woody edge, aquatic habitat, shoreline development, and dredging. Two parameters, terrestrial habitat and aquatic habitat, are composite parameters composed of six sub-parameters. The values of these parameters were determined by summing the products of their measured sub-parameters and respective sub-parameter weights. Dredging is composed of two sub-parameters. Woody edge and shoreline development are simple parameters.

The parameters are converted to a 1-10 scale based on biological sensitivity, with the high portion of the scale corresponding to increasing sensitivity. The scale is reversed for the "negative" factors. Thus, terrestrial habitat, woody edge, and aquatic habitat are on a scale where 10 corresponds to the highest value. Shoreline development and dredging are both on a scale where 1 corresponds to the highest value, indicating the inverse sensitivity measured by these factors. After all the parameter values are converted to a 1-10 scale, they are weighted according to importance and summed for each site. The higher the value, the higher the final ranking, and the higher the biological sensitivity. Although the original scope of work called for a scale of 1-5, the 1-10 scale was used in the analysis to increase the precision in the final ranking.

To reduce subjectivity in developing the weighting factor, the four participating agencies (Corps, FWS, IDOC, and MDOC) independently determined parameter weights. The arithmetic mean of the four values was used for each parameter weight.

This approach does not provide an in-depth analysis of the habitat or the potential for biological degradation at each site. What it does provide is a means of assessing and comparing a large number of sites systematically with the final goal being the identification of those sites which, when compared to the others, are least likely to be important from a biological (habitat) standpoint. The purpose of this

approach is not to select a harbor site from the 29 alternative sites, but to provide a means of comparing the biological value and sensitivity of the sites.

3.1 HABITAT CLASSIFICATION

The first step in performing the overall analysis was to classify the various habitat types at each site. This was done for both the terrestrial and the aquatic habitat. The terrestrial habitat was divided into sand/mud flats, brush lands, bottomland forests, agricultural lands, developed lands, and wetlands. Aquatic habitat was classified by the following categories: main channel, main channel border, backwaters, lakes and ponds, tributaries, and tailwaters. The descriptions used in classifying the terrestrial and aquatic habitats are contained in Appendix C.

The classification was done through analysis of aerial photos, hydrographic maps, and a 1:24,000-scale project base map. The aerial photos provided most of the information. The aerial photographs used in the analysis included black-and-white aerials from 1974 and 1979, color-infrared from 1974, and color aerials from 1979. Except for the color-infrared photos, all aerial photos were taken at 1:24,000-scale. Information derived from the aerial photos was checked against the other aerial photo types. In addition, the information was verified on the ground during a "windshield" survey of all 29 alternative sites.

The hydrographic maps were used to determine the boundaries of the main channel portion of the aquatic habitat. The normal stage bankline forming the landward boundary of the main channel border portion of the aquatic habitat was determined through an averaging of the bankline between the 1974 aerial black-and-whites (depicting a high water stage) and the 1979 black-and-whites and color photos (depicting a low water stage). It should be noted that, due to the forces of erosion and accretion exerted by the Mississippi River, many of the habitat types and the river boundaries themselves vary considerably with season and year.

Information obtained on terrestrial and aquatic habitat is summarized in a series of maps delineating the terrestrial and aquatic habitat types of the 29 alternative harbor sites. These are contained in the accompanying map portfolio.

3.2 BIOLOGICAL EVALUATION PARAMETERS

The importance of different habitat types to fish and wildlife is highly variable. Therefore, in order to assess the "total" habitat value of a site, some provision must be made for weighting the more important habitat types. First, however, a set of criteria to be used in determining the relative

importance of habitats must be developed. In this study, each agency involved in determining parameter weights considered one or more of the following factors when comparing the importance of habitat types:

- Plant and animal species diversity
- Productivity
- Ability to provide significant food and/or cover
- Relative scarcity of habitat type
- Federal and state regulations governing protection of particular habitats

As stated previously, parameter weighting is done through the use of a ranked pairwise comparison technique which assigns importance values to the various habitat classifications. Factor weights are derived by comparing each habitat type against all others, using values 1.0 for the most important, 0.0 for the least important, and 0.5 for factors which are relatively equal. A dummy variable is used to ensure that no factor has a total value of 0. The sum of the values for each habitat type is then divided by the grand total of all the comparisons. The results are the factor or parameter weights.

As previously stated, the factor weights used in this investigation were established in coordination with the St. Louis District of the Corps, the U.S. Fish and Wildlife Service, and the Departments of Conservation for Illinois and Missouri. Each of these agencies prepared a separate set of factor weights which were then averaged together to form the weightings used. The factor weights and the rationales contributed by the agencies are contained in Appendix D.

3.3 GENERAL HABITAT PARAMETER ANALYSIS

A description of each of the computational procedures used to evaluate the major biological parameters in this study is provided below.

3.3.1 Terrestrial Habitat

The terrestrial habitat value for each site is the sum of the weighted values for the individual habitat classifications (e.g., sand/mud flats, brush lands, etc.). Weighted values are obtained by multiplying the unweighted value of the specific habitat type by its respective factor weight. The unweighted values for the individual habitat types were obtained by computing the total area of each type within a site, and then dividing the area of the specific habitat type by the total area of the site. All calculations were made using a planimeter and prepared maps showing the habitat types.

3.3.2 Woody Edge

Woody edge is defined for this investigation as the border between the woody habitat (including bottomland forests and brush) and any adjacent habitats. Considering woody edge as one of the prime factors takes into account the importance of the "edge effect" in determining wildlife productivity and diversity.

The woody edge value for a site was calculated by dividing the total linear woody edge by the total terrestrial area of the site. The total linear woody edge for a site was determined by measuring the border between the brush lands and bottomland forest habitat categories and all adjacent habitats.

3.3.3 Aquatic Habitat

The computation of the aquatic habitat value followed the same procedure as that for the terrestrial habitat. Thus, the aquatic habitat value for each site is the sum of the weighted values for the specific habitat types at the respective site.

3.3.4 Shoreline Development

The amount of developed shoreline at each site is considered important because the disruption of the natural habitat by development has a negative effect on species diversity and productivity. The shoreline development value for each site was determined by measuring the linear amount of developed shoreline for each site and dividing it by the total shoreline of the site. The amount of developed shoreline was determined through analysis of the 1979 aerial photos and field reconnaissance. The land use classification was field-checked before measurements were taken.

3.3.5 Dredging

The biological analysis of the 29 alternative harbor sites also considers the dredging necessary to maintain the river channels by each site. The original scope of work called for the use of dredging frequency per river mile as an index of dredging. However, this approach was considered inadequate because it did not take into account volume of dredged material, which is an important measure of dredging impacts. Moreover, examination of Mississippi River dredging data for 15 years (1964-1979) revealed no discernible correlation between dredging frequency and dredging volume. Therefore, the following dredging index was formulated, which gives equal weight to frequency and volume:

$$D = \frac{f_i}{f_{max}} + \frac{V_i}{V_{max}}$$, Where:

- D = Dredging index
- f_i = Dredging frequency per mile for Site i
- f_{max} = Dredging frequency per mile for the site with the highest frequency of the 29 sites
- V_i = Volume of dredged material per mile for Site i.
- V_{max} = Volume of dredged material per mile for the site with the greatest volume of the 29 sites.

This index was calculated for each alternative harbor site using the 1964-1979 data. This dredging index has a theoretical range of 0 to 2.

3.4 ANALYSIS AND RANKING

The final analysis of the various values obtained for terrestrial habitat, woody edge, aquatic habitat, shoreline development, and dredging involved converting the values to a common scale and then weighting the scaled values to obtain an overall biological rating. As the initial raw values for the parameters were in various units (e.g., areal measures, linear measures, volume measures, etc.), they were converted to a common scale for purposes of further calculation and comparison. Therefore, the values were converted to a 1-10 scale where 10 represents a high biological sensitivity and 1 represents a low sensitivity.

The resulting scaled values for the parameters were then multiplied by their respective factor weights. The factor weights, indicating the relative importance of the parameters, were derived by averaging the sets of factor weights suggested by the four participating agencies.

The next step was to determine the biological rating of each site. This was done by summing the weighted values for each site. The higher the total, the more biologically sensitive the site. The sites were then ranked from 1 to 29 on their biological rating, higher ranks indicating greater sensitivity.

This final ranking is not designed to identify the prime location for a harbor site. It merely indicates those alternatives which are the most and the least biologically sensitive.

4.0 RESULTS

4.1 FACTOR WEIGHTS

The three sets of factor weights used in establishing the importance of the types of terrestrial habitat, the types of aquatic habitat, and the general habitat parameters are the result of input from various state and federal agencies. Tables 1 through 3 below show the factor weights by habitat category submitted by the agencies. The actual rationales used by each agency are contained in Appendix D.

Table 1. ASSIGNMENT OF TERRESTRIAL HABITAT FACTOR WEIGHTS

Factor	Corps	FWS	MDOC	IDOC	Average
Sand/Mud Flats	0.12	0.12	0.12	0.13	0.123
Brush Lands	0.18	0.21	0.14	0.17	0.175
Bottomland Forests	0.25	0.24	0.24	0.27	0.250
Agricultural Lands	0.13	0.12	0.19	0.13	0.143
Developed Lands	0.05	0.05	0.05	0.05	0.050
Wetlands	0.27	0.26	0.26	0.26	0.263
Dummy	0.00	0.00	0.00	0.00	0.000

Table 2. ASSIGNMENT OF AQUATIC HABITAT FACTOR WEIGHTS

Factors	Corps	FWS	MDOC	IDOC	Average
Main Channel	0.05	0.05	0.05	0.06	0.053
Main Channel Border	0.19	0.17	0.13	0.21	0.175
Backwaters	0.21	0.26	0.25	0.21	0.233
Lakes and Ponds	0.19	0.10	0.17	0.17	0.158
Tributaries	0.24	0.26	0.21	0.21	0.230
Tailwaters	0.12	0.17	0.19	0.13	0.153
Dummy	0.00	0.00	0.00	0.00	0.000

Table 3. ASSIGNMENT OF GENERAL HABITAT FACTOR WEIGHTS

Factors	Corps	FWS	MDOC	IDOC	Average
Terrestrial Habitat	0.30	0.23	0.27	0.27	0.268
Woody Edge	0.13	0.30	0.27	0.25	0.238
Aquatic Habitat	0.30	0.27	0.27	0.28	0.280
Shoreline Development	0.13	0.07	0.07	0.08	0.088
Dredging (Spoil)	0.13	0.13	0.13	0.12	0.128
Dummy	0.00	0.00	0.00	0.00	0.000

4.2 RESULTS OF HABITAT EVALUATION

4.2.1 Unweighted Ratings for Terrestrial and Aquatic Habitat

Maps delineating the terrestrial and aquatic habitat types of each site are presented in a separate portfolio. Using these maps, the areas of each terrestrial and aquatic habitat type were measured with a planimeter. The results are shown in Appendix E. The individual habitat areas of each terrestrial and aquatic type were summed to obtain a total area for the terrestrial habitat of each site and likewise for a total aquatic habitat area. Terrestrial habitat areas (sand and mud flats, for example), were then divided by the total terrestrial area to obtain their unweighted rating. These values are given in Table 4. Aquatic habitat ratings were calculated in the same manner, by dividing the area of a particular type of aquatic habitat by the area of the total aquatic habitat. Unweighted aquatic habitat values are given in Table 5.

4.2.2 Weighted Ratings for Terrestrial and Aquatic Habitat

The unweighted ratings for terrestrial habitats in Table 4 were multiplied by their respective factor weights to calculate the weighted ratings for terrestrial habitats, which are given in Table 6. The weighted ratings for all terrestrial habitats for each site were summed to give the terrestrial habitat value of the site. These terrestrial habitat values are also given in Table 6.

The unweighted ratings for aquatic habitats in Table 5 were multiplied by their respective factor weights to calculate the weighted ratings for aquatic habitats, which are given in Table 7. The weighted ratings for all aquatic habitats for each site were summed to give the aquatic habitat value of the site. These aquatic habitat values are also shown in Table 7.

4.2.3 General Habitat Ratings

The unweighted ratings for each general habitat parameter for each site are given in Table 8. The ratings for terrestrial habitat and aquatic habitat are the terrestrial habitat values of Table 6 and the aquatic habitat values of Table 7, respectively. Appendix F shows, for each of the 29 sites, the raw values in meters of woody edge and total site area (Table F-1), developed shoreline and total shoreline (Table F-2), the amount of dredge spoils in cubic yards per year per river mile (Table F-3), and dredging frequency per year per river mile (Table F-4).

TABLE 4. TERRESTRIAL HABITAT UNWEIGHTED RATING

FACTOR	FACTOR WEIGHT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
SAND/MUD FLATS	0.123	0.001	0.016	0.030	0.120	0.010	0	0	0	0.040	0	0	0	0.037	0.040	0	0.013	0.000	0.004	0.000	0	0	0	0	0	0	0.002	0.000	0	0
BRUSH LANDS	0.176	0	0.011	0.021	0.005	0.027	0	0	0	0.005	0	0	0	0	0.004	0	0	0	0	0	0.022	0.041	0.027	0	0	0.027	0.043	0.019	0.020	0
BOTTOMLAND FORESTS	0.250	0.050	0.000	0.100	0.201	0.140	0.527	0.043	0.044	0.100	0.140	0.040	0	0.220	0.341	0.017	0.019	0.010	0.001	0.000	0	0	0.011	0.120	0.003	0.030	0.004	0.220	0.001	0.142
AGRICULTURAL LANDS	0.143	0.000	0.003	0.070	0	0.700	0.303	0.273	0.032	0.717	0	0.011	0	0.530	0.516	0	0	0.150	0	0	0	0	0	0.005	0.074	0.031	0.035	0.732	0.150	0.100
DEVELOPED LANDS	0.060	0.000	0.005	0.050	0.007	0.001	0.170	0.003	0.024	0.040	0.051	0.140	1.000	0.202	0.200	0.003	0.960	0.034	0.035	0.000	0.070	0.041	0.040	0.205	0.263	0	0.005	0.011	0.701	0.066
WETLANDS	0.203	0	0	0.000	0	0.013	0	0	0	0.004	0	0	0	0.002	0	0	0	0	0	0	0	0.010	0.004	0	0	0.005	0.031	0.000	0	0.203

TABLE 5. AQUATIC HABITAT UNWEIGHTED RATING

FACTOR	FACTOR WEIGHT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
MAIN CHANNEL	0.053	0.638	0.577	0.589	0.537	0.479	0.583	0.536	0.428	0.453	0.508	0.477	0.565	0.537	0.487	0.558	0.469	0.477	0.348	0.386	0.172	0.222	0.240	0.612	0.083	0.334	0.258	0.474	0.504	0.381
MAIN CHANNEL BORDER	0.175	0.364	0.383	0.354	0.444	0.467	0.387	0.438	0.571	0.454	0.468	0.482	0.417	0.419	0.501	0.442	0.531	0.523	0.652	0.636	0.828	0.775	0.679	0.384	0	0.649	0.726	0.327	0.343	0.458
BACKWATERS	0.233	0	0	0	0	0.011	0	0	0	0.058	0.024	0	0	0	0	0	0	0	0	0	0	0	0	0.018	0	0.017	0.016	0.169	0.098	0.012
LAKES AND PONDS	0.158	0	0.031	0.019	0	0.009	0	0	0.002	0.037	0	0.017	0	0.019	0	0	0	0	0	0	0	0	0.005	0.004	0.007	0	0	0.019	0.041	0.024
TRIBUTARIES	0.230	0	0.010	0.038	0.018	0.034	0.050	0.026	0	0	0	0.014	0.018	0.026	0	0	0	0	0	0	0	0.003	0.001	0.072	0	0	0	0.012	0.026	0
TAILWATERS	0.153	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.075	0	0	0	0	0	0	0.123

TABLE 6. TERRESTRIAL HABITAT WEIGHTED RATING

FACTOR	FACTOR WEIGHT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
SAND/MUD FLATS	0.123	0.0001	0.002	0.005	0.0155	0.002	0	0	0	0.005	0	0	0	0.005	0.005	0	0.002	0.001	0.0005	0.001	0	0	0	0	0	0	0.0002	0.001	0	0
BRUSH LAND	0.175	0	0.002	0.005	0.015	0.005	0	0	0	0.0009	0	0	0	0	0.0007	0	0	0	0	0	0.004	0.007	0.006	0	0	0.005	0.008	0.003	0.004	0
BOTTOMLAND FORESTS	0.250	0.0125	0.102	0.047	0.073	0.037	0.132	0.161	0.011	0.047	0.037	0.012	0	0.056	0.060	0.004	0.005	0.003	0.015	0.024	0	0	0.003	0.032	0.016	0.009	0.021	0.055	0.015	0.036
AGRICULTURAL LANDS	0.143	0.134	0.072	0.097	0	0.109	0.043	0.038	0.133	0.103	0	0.116	0	0.077	0.074	0	0	0.021	0	0	0	0	0	0.095	0.096	0.133	0.119	0.105	0.023	0.006
DEVELOPED LANDS	0.050	0.0005	0.003	0.003	0.025	0.002	0.009	0.004	0.001	0.002	0.043	0.007	0.05	0.018	0.018	0.049	0.048	0.042	0.047	0.045	0.049	0.047	0.047	0.018	0.013	0	0.0003	0.0006	0.038	0.003
WETLANDS	0.253	0	0	0.002	0	0.003	0	0	0	0.001	0	0	0	0.0005	0	0	0	0	0	0	0	0.005	0.001	0	0	0.001	0.008	0.002	0	0.053
TERRESTRIAL HABITAT VALUE		0.147	0.181	0.159	0.128	0.158	0.184	0.204	0.145	0.159	0.088	0.135	0.050	0.147	0.158	0.053	0.055	0.067	0.063	0.070	0.053	0.059	0.057	0.137	0.125	0.148	0.157	0.167	0.088	0.178

TABLE 7 - AQUATIC HABITAT WEIGHTED RATING

FACTOR	FACTOR WEIGHT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
MAIN CHANNEL	0.053	0.034	0.031	0.031	0.028	0.025	0.030	0.028	0.023	0.024	0.027	0.025	0.030	0.028	0.026	0.030	0.025	0.025	0.018	0.019	0.009	0.012	0.013	0.027	0.048	0.018	0.014	0.026	0.027	0.021
MAIN CHANNEL BORDER	0.175	0.064	0.067	0.062	0.078	0.082	0.068	0.077	0.100	0.079	0.082	0.086	0.073	0.073	0.088	0.077	0.093	0.092	0.114	0.111	0.145	0.136	0.119	0.053	0	0.114	0.127	0.057	0.060	0.079
BACKWATERS	0.233	0	0	0	0	0.003	0	0	0	0.013	0.006	0	0	0	0	0	0	0	0	0	0	0	0	0.004	0	0.004	0.004	0.039	0.029	0.003
LAKES AND PONDS	0.158	0	0.005	0.003	0	0.001	0	0	0.0003	0.006	0	0.003	0	0	0	0	0	0	0	0	0	0	0.001	0.015	0.015	0	0	0.003	0.006	0.004
TRIBUTARIES	0.230	0	0.002	0.009	0.004	0.009	0.012	0.006	0	0	0	0	0.004	0.006	0	0	0	0	0	0	0	0.0007	0.0002	0.017	0	0	0	0.003	0.006	0
TAILWATERS	0.153	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.011	0	0	0	0	0	0	0.010
AQUATIC HABITAT VALUE		0.097	0.105	0.105	0.110	0.119	0.109	0.111	0.123	0.122	0.115	0.117	0.107	0.111	0.114	0.107	0.110	0.117	0.132	0.130	0.154	0.149	0.144	0.116	0.063	0.136	0.145	0.127	0.119	0.126

TABLE 8. GENERAL HABITAT UNWEIGHTED RATING

FACTOR	FACTOR WEIGHT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
TERRESTRIAL HABITAT	0.268	0.147	0.181	0.159	0.178	0.158	0.184	0.204	0.145	0.159	0.080	0.135	0.050	0.147	0.150	0.053	0.055	0.067	0.063	0.070	0.053	0.059	0.057	0.137	0.125	0.140	0.157	0.167	0.080	0.178
WOODY EDGE	0.238	0.0008	0.006	0.003	0.006	0.002	0.006	0.007	0.001	0.003	0.004	0.001	0	0.002	0.003	0.0003	0.0007	0.0002	0.001	0.002	0.0008	0.001	0.002	0.002	0.001	0.001	0.002	0.003	0.002	0.002
AQUATIC HABITAT	0.280	0.097	0.105	0.105	0.110	0.119	0.109	0.111	0.123	0.122	0.115	0.117	0.107	0.111	0.114	0.107	0.110	0.117	0.132	0.130	0.154	0.149	0.144	0.116	0.063	0.136	0.145	0.127	0.119	0.126
SHORELINE DEVELOPMENT	0.088	0.003	0.004	0	0	0	0.156	0.222	0	0	1.000	0	1.000	0.175	0.179	0.933	0.770	0.035	0.394	0.485	0.414	0.342	0.521	0.954	1.000	0	0	0.128	0.268	0.206
DREDGING	0.120	0.42	0.20	0.30	0.30	0.29	0.39	0.30	0.07	0.70	0.06	0.61	0.43	0.17	0.20	0.30	0.73	0.43	1.98	1.82	1.71	0.36	0.61	1.44	0	0.31	0.20	0	0.01	0.20

Values for each general parameter were converted to a 1-10 scale, as discussed in Sections 3.0 and 3.4. These 1-10 scale conversions are given in Table 9, and the scaled values for each site are given in Table 10. For terrestrial habitat, aquatic habitat, and woody edge, high values are rated as 10 and low values as 1. For shoreline development and dredging (negative biological characteristics), high values are rated as 1 and low values as 10.

The general habitat ratings of 1-10 in Table 10 were multiplied by the appropriate factor weights for each general habitat type to calculate the weighted ratings. These weighted ratings for each general habitat type are presented in Table 11. The weighted ratings for each site were summed to obtain the total biological rating for each site. Using these total biological ratings, the sites were ranked according to their biological sensitivity, with the high numbered ranks representing the most sensitive sites and the low numbered ranks representing the least sensitive sites. The biological ratings and final rankings are also shown in Table 11.

4.3 SITE EVALUATION

The final ranking of the 29 alternative harbor sites according to biological sensitivity does not appear to correlate with location (river mile). As the final ranking is based on five general habitat parameters of considerable variation, no one habitat parameter appears to dominate. It should be noted, however, that aquatic habitat, terrestrial habitat, and woody edge are the most important parameters; together they determine 79 percent of the total weight.

The analysis of the weighted ratings and the final ranking is best done on a site-by-site basis, as presented below. For the purpose of this analysis, the median scale value of each general parameter was determined (based on all 29 values) in order to provide a basis for comparison.

These median scale values are: terrestrial habitat, 6; woody edge, 3; aquatic habitat, 6; shoreline development, 8; and dredging, 9. In the following site-by-site analysis, a parameter is considered "mediocre" if the scale value is at or near the median. A parameter scale value exceeding the median is termed "fairly high" to "very high". Similarly, a value less than the median is called "fairly low" to "very low".

Site 1 is located between River Mile 140 and 144, north of Fults, Illinois. The proposed docking facilities for this 2048 hectare (ha) site would cover 1829 meters (m) of the Mississippi shoreline. Site 1 is ranked 15 on the overall biological sensitivity scale. Although this site is relatively high in terrestrial habitat

Table 9. 1-10 CONVERSION SCALE

General Habitat	Habitat Rating	Scale Value
Terrestrial Habitat		
	0.0500 - 0.0654	1
	0.0655 - 0.0808	2
	0.0809 - 0.0962	3
	0.0963 - 0.1116	4
	0.1117 - 0.1270	5
	0.1271 - 0.1424	6
	0.1425 - 0.1578	7
	0.1579 - 0.1732	8
	0.1733 - 0.1886	9
	0.1887 - 0.2040	10
Woody Edge		
	0.0000 - 0.0007	1
	0.0008 - 0.0014	2
	0.0015 - 0.0021	3
	0.0022 - 0.0028	4
	0.0029 - 0.0035	5
	0.0036 - 0.0042	6
	0.0043 - 0.0049	7
	0.0050 - 0.0056	8
	0.0057 - 0.0063	9
	0.0064 - 0.0070	10
Aquatic Habitat		
	0.0630 - 0.0721	1
	0.0722 - 0.0812	2
	0.0813 - 0.0903	3
	0.0904 - 0.0994	4
	0.0995 - 0.1085	5
	0.1086 - 0.1176	6
	0.1177 - 0.1267	7
	0.1268 - 0.1358	8
	0.1359 - 0.1449	9
	0.1450 - 0.1540	10
Shoreline Development		
	0.901 - 1.000	1
	0.801 - 0.900	2
	0.701 - 0.800	3
	0.601 - 0.700	4
	0.501 - 0.600	5
	0.401 - 0.500	6
	0.301 - 0.400	7
	0.201 - 0.300	8
	0.101 - 0.200	9
	0.000 - 0.100	10

Table 9. 1-10 CONVERSION SCALE (Cont.)

General Habitat	Habitat Rating	Scale Value
Dredging		
	1.783 - 1.980	1
	1.585 - 1.782	2
	1.387 - 1.584	3
	1.189 - 1.386	4
	0.991 - 1.188	5
	0.793 - 0.990	6
	0.595 - 0.792	7
	0.397 - 0.594	8
	0.199 - 0.396	9
	0.000 - 0.198	10

Table 10. GENERAL HABITAT UNWEIGHTED RATING ON A 1-10 SCALE

Site	Factor				
	Terrestrial Habitat	Woody Edge	Aquatic Habitat	Shoreline Development	Dredging
1	7	2	4	10	8
2	9	9	5	10	9
3	8	5	5	10	9
4	6	9	6	10	9
5	8	3	7	10	9
6	9	9	6	9	9
7	10	10	6	8	9
8	7	2	7	10	10
9	8	5	7	10	7
10	2	6	6	1	6
11	6	2	6	10	7
12	1	1	5	1	8
13	7	3	6	9	2
14	7	5	6	9	9
15	1	1	5	1	9
16	1	1	7	3	7
17	2	1	6	2	8
18	1	2	8	7	1
19	2	3	8	6	1
20	1	2	10	6	2
21	1	2	10	7	9
22	1	3	9	5	7
23	6	3	6	1	3
24	5	2	1	1	10
25	7	2	9	10	9
26	7	3	10	10	9
27	8	5	8	9	10
28	2	3	7	8	10
29	9	3	7	8	9
Factor Weight	0.268	0.238	0.280	0.088	0.128

Table 11. WEIGHTED GENERAL HABITAT RATINGS AND FINAL BIOLOGICAL SENSITIVITY RANKINGS

Site	Factor						
	Terrestrial Habitat	Woody Edge	Aquatic Habitat	Shoreline Development	Dredging	Biological Rating	Final Ranking
1	1.876	0.476	1.120	0.880	1.024	5.376	15
2	2.412	2.142	1.400	0.880	1.152	7.986	27
3	2.144	1.190	1.400	0.880	1.152	6.766	19
4	1.608	2.142	1.680	0.880	1.152	7.462	25
5	2.144	0.714	1.960	0.880	1.152	6.850	20
6	2.412	2.142	1.680	0.792	1.152	8.178	28
7	2.680	2.380	1.680	0.704	1.152	8.596	29
8	1.876	0.476	1.960	0.880	1.280	6.472	17
9	2.144	1.190	1.960	0.880	0.896	7.070	23
10	0.536	1.428	1.680	0.088	0.768	4.500	10
11	1.608	0.476	1.680	0.880	0.896	5.540	16
12	0.268	0.238	1.400	0.088	1.024	3.018	1
13	1.876	0.714	1.680	0.792	0.256	5.318	14
14	1.876	1.190	1.680	0.792	1.152	6.690	18
15	0.268	0.238	1.400	0.088	1.152	3.146	2
16	0.268	0.238	1.960	0.264	0.896	3.626	4
17	0.536	0.238	1.680	0.176	1.024	3.654	5
18	0.268	0.476	2.240	0.616	0.128	3.728	6
19	0.536	0.714	2.240	0.528	0.128	4.146	7
20	0.268	0.476	2.800	0.528	0.256	4.328	8

LOW RANKINGS = LOW BIOLOGICAL SENSITIVITY

Table 11. WEIGHTED GENERAL HABITAT RATINGS AND FINAL BIOLOGICAL SENSITIVITY RANKINGS (Cont.)

Site	Factor						
	Terrestrial Habitat	Woody Edge	Aquatic Habitat	Shoreline Development	Dredging	Biological Rating	Final Ranking
21	0.268	0.476	2.800	0.616	1.152	5.312	13
22	0.268	0.714	2.520	0.440	0.896	4.838	11
23	1.608	0.714	1.680	0.088	0.384	4.474	9
24	1.340	0.476	0.280	0.088	1.280	3.464	3
25	1.876	0.476	2.520	0.880	1.152	6.904	21
26	1.876	0.714	2.800	0.880	1.152	7.422	24
27	2.144	1.190	2.240	0.792	1.280	7.646	26
28	0.536	0.714	1.960	0.704	1.280	5.194	12
29	2.412	0.714	1.960	0.704	1.152	6.942	22

value, it has little developed shoreline (8 percent), and has been dredged relatively little. Thus, it has a biological ranking which is the median of the 29 sites. The predominantly agricultural land use (with scant woody edge) and absence of desirable aquatic habitat (main channel habitat predominates) contribute to the median ranking.

Site 2 is located in Crystal City, Missouri, between River Mile 146 and 150. This site, which would occupy 218 ha of land, is one of the three most sensitive alternative harbor sites. The rank of 27 results from the extremely high weighted ratings for all general parameters except aquatic habitat. The terrestrial portion of the site is characterized by roughly equal areas of agricultural land and bottomland forest. Less than 7 percent of the land and only 8 percent of the 3277 m shoreline is developed. The aquatic habitat rating is mediocre due to the predominance of main channel habitat. The proposed site plans would require the construction of an inland channel for docking sites.

Site 3 is located between River Mile 150 and 154 in Harrisonville, Illinois and would occupy 1673 ha of land, including 7961 m of shoreline. Plans call for docking sites along a channel to be constructed inland from the river. The biological ranking of Site 3 is 19. The terrestrial habitat rating and woody edge rating of this site are high as a result of substantial bottomland forest. The predominant land use, however, is agricultural. Only 6 percent of the land is developed; a levee area accounts for much of the developed land. The shoreline is characterized by well-developed sand/mud flats and brush land, and has no developed areas. The aquatic habitat value is low as a result of the predominance of main channel habitat. Relatively little dredging has occurred at this site, which overlaps with Site 5.

Site 4 has one of the smallest terrestrial areas (57 ha) of the proposed harbor sites. This site, which is located near Pevely, Missouri, would occupy 1158 m of shoreline, with docking facilities adjacent to the main channel border. The aquatic portion of this site is between River Mile 151 and 155. The overall biological ranking of Site 4 is 25. Although industrially developed lands represent the greatest terrestrial habitat (50 percent), woody vegetation is also well-represented (38 percent). This land use results in a mediocre terrestrial habitat rating and the very high woody edge rating. The riverfront portion of the site is not developed and exhibits sand/mud flats, brush land, and bottomland forest. Relatively little dredging has occurred here. The aquatic habitat of Site 3 is largely main channel, which accounts for the mediocre aquatic habitat rating.

Site 5 is located between River Mile 154 and 158, near Valmeyer, Illinois. This proposed site would occupy 1078 ha of land with 2804 m of shoreline. The proposed dock facility would require a channel to be constructed along the present stream bed of

Fountain Creek. The biological ranking of Site 5 is 20, higher than the ranking of Site 3, which overlaps. The predominant land use is agriculture (77 percent), but bottomland forests represent 15 percent of the site. The woody edge rating, however, is not high. The presence of a 1.4 ha wetland area and the absence of development other than a levee contribute to a high terrestrial habitat rating. The aquatic habitat value at Site 5 is not high because main channel predominates. The shoreline consists of undisturbed sand/mud flats and well developed brush lands. Site 5 also has a high dredging rating.

Site 6 would occupy 394 ha of land in the vicinity of Kimmswick, Missouri. This alternate harbor site is located between River Mile 157 and 161 and covers 5182 m of shoreline, including both shores of the Meramec River. An inland channel would be constructed to accomodate docking sites. Site 6, which has an overall ranking of 28, has the second highest sensitivity of the 29 harbor sites. The high overall ranking results largely from high terrestrial habitat, woody edge, and dredging ratings. In addition, only 16 percent of the shoreline is developed. Extensive areas of bottomland forest (53 percent) account for both the high terrestrial habitat rating and the considerable woody edge. Agricultural lands occupy 30 percent of the site. The developed lands include a power plant and residential areas. The aquatic habitat value of Site 6 is mediocre, in spite of the presence of a significant tributary, the Meramec River. Main channel habitat predominates. Site 6 overlaps extensively with Site 7.

Site 7 is smaller (259 ha) than Site 6 but occupies almost the same general geographical area. The proposed docking facilities for Site 7 would be located along the Mississippi shore. Including both shores of the Meramec River in addition to the Mississippi shoreline, Site 7 would contain 5486 m of shoreline. This harbor site has a biological rank of 29, and thus is the most sensitive site. The terrestrial habitat and woody edge ratings are higher than those of Site 6, and the shoreline development rating is lower than that of Site 6. The differences between these two sites are due to the following:

- Site 7 does not include the developed power plant land in Site 6.
- Site 7 contains a smaller segment of the Meramec River.

Site 8 is near Warnock, Illinois, and is located between River Mile 162 and 166. The terrestrial portion of the site comprises 1299 ha. Docking facilities would be placed along the 347 m of shoreline. Site 8 is ranked 17 in overall biological sensitivity. The terrestrial habitat rating is fairly high, although 93 percent of the land is in agricultural use. The only significant developed area is associated with the levee. The relatively scarce bottomland forest and absence of brush lands account for

the low woody edge rating. The aquatic habitat at Site 8 is rated relatively high because of a large portion (57 percent) is main channel border habitat. Finally, the high dredging rating and the absence of shoreline development increase the overall ranking of this alternative harbor site.

Site 9 is located west of Columbia, Illinois between River Mile 165 and 168 on 973 ha of land. This site extends along 6212 m of shore both north and south of the Highway 270 - Route 50 bridge. The proposed harborage, however, would be along a planned inland channel. The biological sensitivity ranking of Site 9 is 23. This site is characterized by relatively high terrestrial habitat, aquatic habitat, and woody edge ratings. Although 72 percent of the land is agricultural, a healthy stand of bottomland forest occurs along the shore, intersected by a long slough. There are also sand/mud flats bordering most of the shoreline. The only developed land at this site is a strip along the levee. The aquatic portion of Site 8 consists of almost equal areas of main channel and main channel border, the abovementioned slough, and several lakes. There is no developed shoreline and the dredging rating is mediocre.

Site 10 is located just south of the bridge in Missouri. This site has the smallest land area (21 ha) of the 29 alternative harbor sites, and the aquatic portion is located between River Mile 166 and 170. The docking area would be located along the 914 m shoreline. Site 10 is ranked 10 on the biological sensitivity scale. The low ranking is largely due to poor terrestrial habitat, mediocre aquatic habitat, and an entirely developed shoreline. Commercially developed lands occupy 85 percent of the site. The relatively high woody edge rating is mostly attributable to the small site area. With the exception of some backwater, aquatic habitat at Site 10 consists of mostly main channel and main channel border habitat. This site has a relatively low dredging rating.

Site 11 encompasses the East Carondelet and North Dupo areas of Illinois and River Mile 170 to 174. This site, which overlaps with Site 13, has a land area of 1613 ha and a shoreline of 1219 m. The harborage would be located along the existing shoreline. Site 11 is ranked 16 in biological sensitivity. The terrestrial and aquatic habitat ratings are mediocre, and the woody edge rating is very low. Land use is mostly agricultural (81 percent), but 14 percent of the land is developed for commercial, residential, and levee purposes. Bottomland forest occupies about half of the shoreline, which is entirely undeveloped. Most of the aquatic habitat consists of main channel and main channel border habitats which are represented in roughly equal proportions. The dredging rating for this site is relatively low.

Site 12 would occupy 73 ha of land just north of the River des Peres Drainage in St. Louis. The aquatic portion of the site extends between River Mile 171 and 175. Site 12 would have harborage along th 689 m shoreline. This alternative harbor site has an overall ranking of 1, thus is the site with the least biological sensitivity. Very low terrestrial habitat, woody edge, aquatic habitat, and shoreline development ratings account for the low overall rank. This site is entirely developed; the shoreline is developed commercially and the inland portion is developed for residential purposes. Consequently, there is no measurable woody edge. The aquatic habitat is 57 percent main channel, and 42 percent main channel border. In addition, the dredging rating for this site is mediocre.

Site 13 is situated on 1306 ha bordering Cahokia, Illinois, between River Mile 172 and 175 of the Mississippi River. The proposed docking area would be located on a channel extending inland from the 8955 m harbor shoreline. Part of Site 13 overlaps Sites 11, 14, and 15. This harbor site has an overall ranking of 14, which is just below the median biological sensitivity ranking. The terrestrial habitat value is above the median. Agricultural land predominates (54 percent) but bottomland forest and developed lands are also well-represented (22 percent and 20 percent, respectively). The northern part of the site is more developed than the southern part. The development is generally commercial along the shore and residential inland. Sand/mud flats border part of the shoreline, and a small wetland occurs inland. Site 13 has a mediocre woody edge rating and a high shoreline development rating. The dredging rating at this site is very low. The aquatic habitat value is mediocre; main channel predominates (42 percent). A few lakes and one tributary also fall within the boundaries of this site.

Site 14 would occupy 734 ha of land bordering Cahokia, Illinois. This alternative harbor site overlaps considerably with Site 13 and stretches along 4499 m of shoreline, part of which would be developed for harborage. The aquatic portion lies between River Mile 174 and 178. Site 14 ranks 18 in biological sensitivity. The terrestrial habitat and woody edge ratings for this site are above the respective medians. Bottomland forest, which occupies 24 percent of the land, contributes to both of these parameter values. Agricultural lands, however, predominate at this site (52 percent), and developed lands are also well-represented (20 percent). As at Site 13, the developed areas are both commercial and residential. Because most development occurs inland from the river, the shoreline development rating is high. The aquatic habitat rating at Site 14 is not high because only main channel and main channel border habitats occur there. The dredging rating is fairly high.

Site 15 is located just south of the MacArthur Bridge in East St. Louis, Illinois. The southern boundary for this harbor site is the northern boundary of Site 14, and it overlaps with Site 13. The aquatic boundaries for this site are approximately River Mile 176 and 179, and docking sites would be located along part of the 3658 m of riverfront. Site 15 has a ranking of 2, thus has one of the lowest biological sensitivities of the 29 harbor sites. The terrestrial habitat, woody edge, aquatic habitat, and shoreline development ratings for this site are all very low. The land area is entirely developed except for a 5 ha stand of bottomland forest. The development is largely industrial and includes some large areas of open industrial wasteland, bare or vegetated with grasses and/or shrubs. The aquatic habitat is 56 percent main channel, and 44 percent main channel border. The only general parameter with a fairly high rating is dredging.

Site 16 is located between Eads Bridge and McKinley Bridge in East St. Louis, Illinois, and overlaps considerably with Site 17. The aquatic boundaries of Site 16 are approximately River Mile 178 and 182, and the terrestrial portion occupies 4005 m of shoreline. The docking area would be along the shore of the Mississippi River. This site is ranked 4; thus, it is one of the 29 alternative harbor sites with the least biological sensitivity. Terrestrial habitat and woody edge values are rated very low for this site. Except for a narrow strip of forest bordering part of the river front, this site is entirely developed commercially. Open areas which are bare or vegetated with grasses and/or upland shrubs are numerous. Main channel (47 percent) and main channel border (53 percent) are the only aquatic habitat types represented; the aquatic habitat rating is above the median value. The shoreline development and dredging ratings are fairly low.

Site 17 occupies all of the same shoreline of East St. Louis as Site 16, but extends farther north, south, and east. The aquatic boundaries are River Mile 179 and 182. There is also some overlap between Site 17 and Site 18. This site would occupy 705 ha of land with a 4840 m shoreline. Site 17 has a biological ranking of 5. All general parameter ratings are very low except for dredging and aquatic habitat, which have mediocre ratings. The terrestrial portion of Site 17 is 83 percent developed, 15 percent agricultural, and 1 percent bottomland forest. As with Site 16, the developed land includes large, open areas of industrial wasteland, and 84 percent of the shoreline is developed. The aquatic part of this site is 48 percent main channel and 52 percent main channel border.

Site 18 is situated just west of Madison, Illinois, where the southern end of Chain of Rocks Canal joins the Mississippi River. This harbor site would occupy 655 ha of land, including 3773 m of shoreline, and the aquatic boundaries are River Mile 182 and 185. A new inland channel would be dredged to provide

for harborage. Site 18 overlaps considerably with Site 19 and to a lesser extent with Site 17. The biological sensitivity ranking is 6. Very low terrestrial habitat, woody edge, and dredging ratings contribute to the low overall ranking. Ninety-four percent of the land is developed. Most of the development is commercial, but some development is associated with the levee area. Part of the shoreline, which includes riverfront and canal, is bordered by bottomland forest. The aquatic habitat value is well above the median because 65 percent of the aquatic habitat is main channel border. The shoreline development rating is fairly high because only 39 percent of the shoreline is developed.

Site 19 is located just west of Madison, Illinois, and is within the boundaries of Site 18. This site would occupy 325 ha of land, with a 2365 m shoreline. About half of the shoreline borders the Chain of Rocks Canal and the other half borders the Mississippi River. Docking sites would be constructed along the part of the existing shoreline. Although most of Site 18 is included within Site 19, Site 19 has the higher ranking. This site ranks 7 in biological sensitivity. All parameter ratings at Site 19 are identical to or higher than Site 18 except for shoreline development, which rates higher at the latter site. The land use and aquatic habitat at Site 19 are similar to Site 18. Site 19 has a higher proportion of bottomland forest than Site 18, however, this difference is a result of the smaller overall land area at Site 19. In addition, the Chain of Rocks Canal is better represented at Site 19 than at Site 18.

Site 20 is located in northern St. Louis, Missouri between River Mile 182 and 185. The land area is 244 ha and includes 1487 m of shoreline. The northeastern tip of this site overlaps with the southwestern tip of Site 21. The biological sensitivity ranking of Site 20 is 8. This ranking reflects the extremely low parameter ratings for terrestrial habitat value, woody edge, and dredging. The terrestrial portion of Site 20 is 98 percent developed and 2 percent brush lands. Development is largely for commercial and industrial purposes; some open "wasteland" areas are included. The brush land occurs in a narrow strip along part of the shore. The aquatic habitat rating is among the three highest of the 29 sites, because 83 percent of the aquatic portion is main channel border habitat. The preponderance of main channel border habitat is related to the presence of two large islands (Mosenthein and Gabaret). The shoreline of Site 20 is 41 percent developed, which accounts for the fairly low shoreline development rating.

Site 21 is situated in northern St. Louis, Missouri on 262 ha including 2670 m of shoreline. This alternative harbor site overlaps with Sites 20 and 22; the aquatic boundaries are approximately River Mile 185 and 189. The proposed docking area would be located along part of the shoreline. The biological

sensitivity ranking of Site 21 is 13. The terrestrial habitat and woody edge ratings are low, because 94 percent of the land is developed and only 4 percent is brush lands. A narrow stand of brush lands borders the shore and the balance of the site is developed for commercial/industrial purposes, except for a small wetland area. Some of the developed land is open and vegetated with grasses and/or shrubs. The aquatic habitat at Site 21 is one of the three highest of the 20 alternative harbor sites. As with Site 20, the large area of main channel border associated with Mosenthein Island and Gabaret Island accounts for the high aquatic habitat rating. Site 21 has a mediocre shoreline development rating (34 percent is developed) and a fairly high dredging rating.

Site 22 is located between River Mile 183 and 191 and covers 855 ha of the northernmost part of St. Louis, Missouri. Docking facilities would be located along part of the 9949 m shoreline as well as along a planned inland channel. This site encompasses most of Site 20 and all of Site 21. The biological sensitivity ranking is 11. A very low terrestrial habitat value and a fairly low woody edge and shoreline development ratings account for this ranking. Except for a narrow border of woody vegetation along the river and a creek, and a small wetland area, the entire site is developed. Most of the land exhibits industrial and commercial land use, but residential development is also present. The aquatic habitat value of Site 22 is enhanced by a large main channel border area (68 percent). As with Sites 20 and 21, the main channel border is associated with Mosenthein and Gabaret Islands. Fifty-two percent of the shoreline is developed. The dredging rating at Site 22 is below the median.

Site 23 is a 1295 ha site located west of Granite City, Illinois, along the Chain of Rocks Canal. The aquatic portion of this site includes the Chain of Rocks Canal above Lock No. 27, as well as the Mississippi River from Mile 193 to 196 and from Mile 183 to 185. The proposed harborage for this site would include two sections of the 12003 m shcre of the Chain of Rocks Canal. Site 23 overlaps considerably with Site 24. The overall biological sensitivity ranking for this site is 9. The terrestrial habitat and woody edge ratings of this site are mediocre. A large portion (67 percent) of the land is in agricultural use, 20 percent is developed, and 13 percent is bottomland forest. The developed areas include a levee as well as commercial and industrial development. The aquatic habitat rating of Site 23 is not high, due to the significant representation of the Chain of Rocks Canal, which is classified as Main Channel. Site 23 has a very low shoreline development rating; 95 percent of the shore is developed. The dredging rating is also very low.

Site 24 occupies much of the same area west of Granite City, Illinois, as does Site 23. Site 24 covers 967 ha of land and 7620 m of Canal shoreline. The docking area would be constructed along the Chain of Rocks shoreline. No main stem river habitat is included in the aquatic portion of this site. The overall ranking of Site 24 is 3. The very low ranking is due to a mediocre terrestrial habitat and low woody edge, shoreline development, and aquatic habitat ratings. Because much of the land is the same, land use at Site 24 is similar to Site 23. Site 24, however, has a smaller proportion of bottomland forest and larger proportion of developed lands than Site 23. Site 24 has the lowest aquatic habitat rating of all the 29 harbor sites because the Chain of Rocks Canal accounts for 90 percent of the aquatic area. The high dredging rating for Site 24 is probably misleading, because there were no dredging data available for the Chain of Rocks Canal. For the purpose of the analysis, the canal was considered to have had no dredging between 1964 and 1979. Therefore, it is probable that Site 24 would be ranked even lower than 3 in biological sensitivity if the dredging data were available.

Site 25 is situated between Mile 191 and 195 and would occupy 602 ha of land east of Spanish Lake, Missouri. The docking sites would be located on an inland channel to be built perpendicular to the 3011 m shoreline. The overall ranking of Site 25 is 21. The terrestrial habitat and dredging ratings are fairly high, and the shoreline development and aquatic habitat ratings are very high for this site. Ninety-three percent of the land is agricultural, 4 percent is bottomland forest, and 3 percent is brush land. The woody edge rating is low. Brush lands or bottomland forest border the main shoreline and a side channel. Main channel border (65 percent) prevails over main channel habitat, and a side channel provides backwater habitat.

Site 26 is located east of Spanish Lake, Missouri, between River Mile 190 and 195. This site, which has the largest land area of the 29 alternative harbor sites, encompasses 1794 ha. The 10,022 m shoreline, some of which would be developed as harborage, includes the Missouri River as well as Mississippi River riverfront. Site 25 is wholly included in the land area of Site 26. The overall ranking of this harbor site is 24. The terrestrial habitat and dredging ratings are fairly high; and the shoreline development and aquatic habitat ratings are extremely high. Agricultural lands predominate (84 percent), but all other terrestrial habitat types, including wetlands, also occur. Much of the bottomland forest, brush land, and wetland habitat is located in one large, rather undisturbed tract bordering the Missouri River. Because of this land distribution, the woody edge rating is rather low. Less than 1 percent of the land at Site 26 is developed. A large area of main channel border enhances the aquatic habitat value of Site 26.

Site 27 is situated east of West Alton, Missouri between River Mile 196 and 200. This 1053 ha site would occupy 6255 m of shoreline. The plans for this site call for a new inland channel to provide a docking area. This channel would go through Maple Island. The overall ranking of Site 27 is 26; which places this site among the four most highly ranked of the 29 alternative harbor sites. Shoreline development and dredging ratings are very high for this site. At present, the only developed land on the site is a riverfront tract which is being cleared by the Corps for construction of a new Lock and Dam No. 26. The terrestrial habitat and woody edge ratings are also fairly high for Site 27. Approximately 73 percent of the land use is agricultural and 22 percent bottomland forest. The amount of land cleared by the Corps was estimated as 1 percent of the entire site on the basis of observations made during field verification of the aerial photos; the October 1979 aerial photos showed no cleared land. A large area of bottomland forest, brush land, and wetlands is located on Maple Island, which is separated from the rest of the site by a narrow side channel. Main channel border, backwater, and tributary habitats together account for 51 percent of the aquatic area at Site 27. The aquatic habitat at this site has a fairly high rating. The biological sensitivity ranking of Site 27 is expected to decrease in the near future because of extensive habitat alterations associated with the construction of Lock and Dam No. 26.

Site 28 encompasses Alton and East Alton, Illinois. This 1380 ha site has a shoreline of 9754 m. The aquatic portion of Site 28 lies between River Mile 196 and 201. Docking sites would be constructed along the shore of the Mississippi. Site 28 has an overall ranking of 12. A very low terrestrial habitat rating and mediocre woody edge and aquatic habitat ratings contribute to the low overall rating. Seventy-six percent of the site is developed and 16 percent is used for agriculture. Only 8 percent of the site is bottomland forest or brush land; which occur along the shores of the Mississippi River and the Wood River. Developed lands are mostly commercial or industrial near the river and residential elsewhere. The aquatic habitat is 50 percent main channel and 34 percent main channel border. Backwater, lake and tributary habitats are also present. A median shoreline development rating (only 25 percent of the shoreline is developed) and a very high dredging rating characterize this site.

Site 29 is located near West Alton, Missouri between River Mile 201 and 205. This alternative harbor site would occupy 596 ha of land with a 3200 m shoreline. Harborage would be located on a channel which would intersect a wetland area. The overall ranking for Site 29 is 22. The terrestrial habitat rating is very high, and the shoreline development and dredging ratings are fairly high. The land use is 60 percent agricultural, 20 percent wetland, and 14 percent bottomland forest. The wetland area is largely composed of emergent aquatic plants; water lily (Nymphaeceae family) is the dominant species. Most of the

developed land is associated with Lock and Dam No. 26. The woody edge rating is fairly low. The aquatic portion of Site 29, which is 45 percent main channel border and 39 percent main channel habitat, includes all other types of habitats considered in this study except tributaries. Dam No. 26 creates a tailwater area and a large main channel border. Large areas of impounded water are also present. The aquatic habitat rating is above the median.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

The habitat evaluation technique used in this study indicates that five alternative harbor sites have biological sensitivity rankings of 5 or less. These sites, and their respective rankings are:

- Site 12 (Rank 1)
- Site 15 (Rank 2)
- Site 24 (Rank 3)
- Site 16 (Rank 4)
- Site 17 (Rank 5)

All of these sites have poor to mediocre terrestrial habitat, little woody edge, and high shoreline development, and most also have poor to mediocre aquatic habitat and a large amount of dredging.

Conversely, the five alternative harbor sites with the greatest biological sensitivity and their respective ranks are:

- Site 7 (Rank 29)
- Site 6 (Rank 28)
- Site 2 (Rank 27)
- Site 27 (Rank 26)
- Site 4 (Rank 25)

With few exceptions, the five most sensitive sites are characterized by good terrestrial habitat, significant woody edge, low shoreline development, mediocre aquatic habitat, and infrequent dredging. As previously mentioned, Corps construction activities at Site 27 may reduce the biological sensitivity of this site. In this event, Site 26 (Rank 24) will become one of the five most biologically sensitive alternative harbor sites.

In conclusion, it should be emphasized that the findings of this study are highly dependent on the parameter weights and the land use classifications. The validity of the biological sensitivity rankings determined in this study depends on what changes occur in the near future at the 29 alternative harbor sites. Large scale land development (such as the work associated with Lock and Dam No. 26) might reduce the biological sensitivity of a site. Finally, parameter weights are site specific for the Mississippi River in the St. Louis area, and would not necessarily apply to other areas.

5.2 RECOMMENDATIONS

Based upon the results of the site comparisons, it is recommended that in biological terms those sites falling within the lowest 5 ranks (Sites 12, 15, 24, 16, and 17) be most favored for further study as potential harbor locations. These sites have the least habitat value, consequently, further development would probably result in fewer adverse impacts at these sites than at the other sites.

An additional recommendation relates to the methodology used in this study. The experience gained during this project points out ways in which the methods of evaluation could be improved for future use in projects of this nature. Additional and more accurately defined land use classifications would have been useful in evaluating many of the sites. The inclusion of a separate terrestrial category described as "urban open",for example, would have enabled a better evaluation of many sites. Under the classification system used, open, vegetated areas amidst industrial development had to be placed in either the developed lands or agricultural lands category, according to the judgement of the personnel visiting the site. To be consistent, these lands were classified as developed lands. Such urban open areas, however, represent a unique category in terms of wildlife habitat value. Accordingly, these lands should be classified separately. Similarly, it may be useful to classify old field habitat apart from other agricultural lands due to their significant wildlife habitat value.

6.0 REFERENCES

Dee, N. et al. 1972. Environmental Evaluation System for Water Resource Planning. Battelle-Columbus Laboratories. Columbus, OH. NTIS PB-208-822.

Shaw, S. P. and C. G. Fredine. 1956. Wetlands of the United States, Their Extent and Their Value to Waterfowl and Other Wildlife. Circular 39. Fish and Wildlife Service, USDI.

U.S. Army Corps of Engineers. 1979. Dredge Material Summary 1974 - 1979. St. Louis District. St. Louis, MO.

_____. 1978. Dredge Material Summary 1964 - 1973. St. Louis District. St. Louis, MO.

_____. 1978. Hydrographic Survey Maps of the Mississippi River, River Mile 0 to Mile 202. St. Louis District. St. Louis, MO.

_____. 1978. Hydrographic Survey Maps of the Mississippi River, River Mile 202 to Mile 300. St. Louis District. St. Louis, MO.

_____. 1980. Quantitative Report, Upper Mississippi and Lower Illinois Rivers, Pools 24, 25, and 26, Terrestrial and Aquatic Land Use and Habitat Change as a Result of the Nine-Foot Channel Project. St. Louis District. St. Louis, MO.

_____. 1978. Upper Mississippi River Navigation Charts. U.S. Army Engineer Division, North Central. Chicago, IL.

Warner, M. L. et al. 1974. A Review of Environmental Impact Assessment Methodologies. Battelle-Columbus. Columbus, OH. NTIS PB-236-609.

APPENDIX A

SELECTION CRITERIA
FOR THE 29 ALTERNATIVE HARBOR SITES

CRITERIA CONSIDERED IN SELECTING HARBOR SITES

A.T. KEARNEY

Selection Criteria		
Critical	Important	Minor
Environmental Accessibility	Land-side Accessibility	Financing and Taxes
	Utility Availability	Labor Availability/ Cost
	Parcel Suitability for Desired use	Restrictions and Zoning
	Location Relative to Markets	Governmental Jurisdiction
	Protection from Flooding	
	Water-side Accessibility	
	Proximity to Fleeting Areas	

General

A. Land-side Criteria
   1. Land-side accessibility: Availability of road, rail and pipeline.
   2. Utility availability: Access to electric power, water, sewage treatment, and natural gas.
   3. Parcel suitability: Size, shape, present use, and topography.
   4. Location relative to market: Location in relation to origins of inbound raw materials and destinations of finished products.

B. Water-side Criteria
   1. Protection from flooding: levees, flood walls, highground.
   2. Accessibility: Depth of water at site, potential for siltation, distance to main channel.
   3. Location of the nearest fleeting areas.

12 Development Oportunities

A. Direct access to either Burlington Northern or Missouri Pacific Railroad.
B. Acreage available to specific development opportunity.
C. Located below Lock and Dam 26 to avoid expensive locking delays.
D. Good road connections or capable of being developed.
E. Like facilities available as a source of raw materials.
F. Located near potential sources of coal, natural gas, and steam.
G. Adjacent to a major petroleum product pipeline.
H. Location should be capable of being physically separated from surrounding area.
I. Year-round navigation service.
J. Flood protected and have direct access to river bank.

CORPS

Hydrographic conditions
Topography
Flood heights
Maintenance dredging
Effect on operation of existing gravity drains
River currents
Floodway opening
Bankline
Congestion
Present use
Fleeting availability
Archeological
Availability of utilities
Road and rail access
Access to pipeline

APPENDIX B

INFORMATION REGARDING
1 JULY 1980 COORDINATION MEETING

ST. LOUIS HARBOR STUDY

Meeting Agenda
1 July 1980

I.	9:30- 9:40	INTRODUCTIONS AND OPENING REMARKS
II.	9:40- 9:45	PURPOSE OF MEETING
III.	9:45-10:00	HISTORICAL BACKGROUND TO ST. LOUIS HARBOR STUDY

A. PURPOSE
B. PRESENT PLANNING STAGE
C. OUTSIDE CONTRACT AND STATUS
D. ENVIRONMENTAL STUDIES SECTION INVOLVEMENT

IV.	10:00-10:15	HISTORICAL BACKGROUND TO FISH AND WILDLIFE EFFORT

A. INITIAL SCOPING MEETING (28 AUG 79)
B. STUDY PROPOSAL (14 SEP 79)
C. SCOPES OF WORK

V.	10:15-12:00	SUBJECT SCOPE OF WORK

A. PURPOSE
B. COORDINATION TO DATE
C. VERSAR, INC.
D. METHODOLOGY
E. COMMENTS

VI.	12:00-12:15	CLOSING REMARKS AND ADJOURNMENT

ST. LOUIS HARBOR STUDY COORDINATION MEETING

(1 July 1980)

ATTENDANCE SHEET

NAME	ORGANIZATION
Donald R. Henne	U.S. Fish and Wildlife Service
Ronald Zongrich	Illinois Dept. of Trans.-Dist.8
Bob Schanzle	Illinois Dept. of Conservation - Planning
Norm Stucky	Mo. Dept. of Conservation
Howard Markus	Mo. Dept. of Natural Resources
Bill Boyd	Ill. Dept. of Cons.-Fisheries
Leslie Adkins	Versar, Inc.
Carey W. Burch	Versar, Inc.
David A. Rudich	Versar, Inc.
David Gates	St. Louis District, Corps of Engineers

Versar inc.

LETTER SENT TO ATTENDEES
JULY 1 COORDINATION MEETING

Dear (_____):

I enjoyed meeting with you on Tuesday (1 July 1980) and am looking forward to working with you on the St. Louis Harbor Study. Versar's draft of the Limited Biological Resources Evaluation of 29 Alternative Harbor Sites will be submitted to the St. Louis District of the Corps and all other involved agencies for comment around the middle of August 1980. Therefore, I would appreciate receiving your agency's input to the factor weights by 21 July 1980. If you have any questions regarding the methodology being used, please contact me at (703)750-3000. I appreciate your time and input.

Sincerely,

Carey W. Burch
Environmental Planning Division

CWB:nld
Encl. Attendance Sheet

6621 ELECTRONIC DRIVE, SPRINGFIELD, VIRGINIA 22151 TELEPHONE: (703) 750-3000

Versar inc.

SUMMARY OF COMMENTS FROM 2ND COORDINATION MEETING

DATE:

ADDRESS:

ATTENTION:

Dear _____:

I wish to thank you for your participation in the meeting on 26 September 1980. The comments received on the draft report entitled "A Limited Biological Resources Evaluation of 29 Alternative Harbor Sites" were helpful, and should add to the analysis and comparison provided by the report.

There were three main comments agreed upon which will involve changes within the report and its ranking of the harbor sites by their respective biological resources. First, it was decided to incorporate the frequency of dredging into the current dredging parameter on an equal basis. This is intended to more clearly represent the potential for impacts related to dredging at each possible harbor site. Second, a change was made in the classification of aquatic habitat, moving "canals" from Backwater to Main Channel. This change corrects the situation where the Chain of Rocks Canal was classified as a Backwater, with a high aquatic habitat value, when its actual characteristics resemble a Main Channel area. The third change involves the use of a 1-10 scale for the parameters in lieu of the 1-5 scale. The 1-10 scale provides more detail to be carried over into the final weighting and ranking. In addition to these three comments, minor wording changes were made to clarify certain areas in the draft report.

If you have any questions or comments on the 26 September meeting or the draft report, please contact me. Again, thank you for your participation.

Sincerely,

Carey W. Burch
Environmental Planning Division

CWB:nld
Encl. A List of Attendees, 26 September Coordination Meeting

6621 ELECTRONIC DRIVE, SPRINGFIELD, VIRGINIA 22151 TELEPHONE: (703) 750-3000

26 September 1980

COORDINATION MEETING - ALTERNATIVE HARBOR SITING STUDY

List of Attendees	Agency
Bruce Yurdin	Illinois EPA
Bob Schanzle	Illinois Dept. of Conservation Impact Analysis
John Puricelli	Illinois Dept. Transportation Environmental Section
Mike Cochran	Illinois Dept. of Conservation - Strea
Don Henne	U.S. Fish and Wildlife
Norm Stucky	Missoui Dept. of Conservation
Dave Gates	St. Louis Corps
Carey Burch	Versar, Inc.
Leslie Adkins	Versar, Inc.

APPENDIX C

TERRESTRIAL AND AQUATIC HABITAT CLASSIFICATIONS

HABITAT CLASSIFICATION

1. Terrestrial Habitats.

a. Sand/Mud Flats. A sand/mud flat is newly formed land or land uncovered by the recession of water. Such flats are bare or sparsely vegetated with annual grasses, composites, sedges and some seedlings of woody species. Normal river stage will be used for the purpose of defining the riverward extent of this habitat type.

b. Brush Lands. This vegetation occurs on young sand and mud bars elevated slightly above the adjacent sand and mud flats. Young, and often even-aged, sandbar willow, black will asnd cottonwood dominate the canopy. These species occur in pure and mix stands and range from finger-sized saplings near the sand and mud flats to medium-aged trees on the higher sites. Woody vegetation up to approximately 15-feet in height will be included in this habitat category.

c. Bottomland Forests. Areas containing at least 50 percent trees (crown closure)-over 15 feet tall. Open areas larger than 1.0 acre within a general forest boundary will be delineated. The species composition of this type is primarily cottonwood, black willow, American elm, silver maple, box elder, green ash and river birch, with some basswood, hickory and oak on the better-drained sits. This habitat type includes plantations on abandoned agricultural land.

d. Agricultural Lands. Open areas devoted to annual crops,

pasture, old field and landscape nurseries. Marsh lands are included in this category if they exhibit characteristics of agricultural use.

e. Developed Lands. Open areas which are either: (1) dominated by industrial or commercial types of buildings or activities; or (2) showing signs of earth-moving activities (includes roads, highways and railraods and their consequent cuts and fills, coal terminals, gravel pits, marinas, and industrial buildings); or (3) areas occupied by residence and related features such as lawns and woodlots along with residential streets. Levee areas and urban open land (open undeveloped land lying idle in the midst of urban or industrial areas) are included in this category.

f. Wetlands. This habitat includes wetland types 2, 3, 4, 6 and 7, as classified by the U.S. Fish and Wildlife Service in Circular 39.

2. Aquatic Habitats.

a. Main Channel. The main channel will be defined as the navigable portion of the river, with water depths of 9 feet or greater. The delineation of this habitat will be based on existing hydrographic data. The border for this habitat type will be approximated using the 10-foot contour lines (LWRP) indicated on the hydrographic maps provided. Most of the main channel is subject to scouring action during periods of rapid water flow and by the passage of towboats stretches. No rooted aquatic vegetation is present. Canals are included in this category.

b. Main Channel Border. This habitat is defined as the region of the main river that extends between the main channel and the main river bank. A normal stage bankline will be approximated by a line averaging the shorelines depicted by 6 April 1975 aerial photos taken at a high water stage of 20.7 feet, St. Louis Gage, and 13 October 1979 photos taken at a low water stage of 3.5 feet, St. Louis Gage. The bankline will be determined using the aerial photos provided. These photos will show a near normal river stage. Little or no rooted aquatic vegetation is present in the main channel border area.

c. Backwaters. These include departures from the main river that are still connected to the river during normal river stage. The normal stage shoreline will be determined in the same manner as that described for the main channel border. Other terms that have been used for this habitat are side channel, slough, running sloughs, chute, cut, gut, and cutoffs. In swifter current, there is no rooted aquatic vegetation, but vegetation is found in the shallower areas having silty bottoms and moderate to no current.

d. Lake and Ponds. These represent departures from the main river that are not connected to the river during normal stage. Artificially developed ponds and lakes will be included in this category. River lakes and ponds may or may not have a slight current, depending on their location. Most of the bottoms are mud or silt. These waters may have an abundance of rooted aquatic vegetation. The circular 39 wetland type 5 is included in this habitat type.

e. Tributaries. Tributary rivers and creeks will be included in this category. The extent of their inclusion will be defined landward by the terrestrial site boundaries.

f. Tail-Waters. These include the main channel, main channel border, and other areas immediately below dams which are affected in turbulance by the passage of water through the gates of the dams and out of the locks. An arbitrary lower boundary for fishery purposes will be set at a distance of one-half mile below the dams. The bottom type in these areas is mostly sand, rock, or rubble. No rooted aquatic vegetation is present.

APPENDIX D

AGENCY INPUT FOR FACTOR WEIGHTS

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO ATTENTION OF

LMSED-BA

18 July 1980

Mr. Carey Burch
Versar, Inc.
6621 Electronic Drive
Springfield, VA 22151

Dear Carey:

This letter forwards to your office the District's input to the overall determination of parameter weights as required by the Scope of Work titled "A Limited Biological Resources Evaluation of 29 Alternative Harbor Sites - St. Louis Harbor Study."

Inclosures 1 through 3 provide the worksheets and rationale used by the District in determining the weights for the terrestrial, aquatic and biological analyses.

Sincerely,

JACK F. RASMUSSEN
Chief, Planning Branch

3 Incl
As stated

ASSIGNMENT OF BIOLOGICAL ANALYSIS FACTOR WEIGHTS
BASED ON THE RANKED PAIRWISE COMPARISON TECHNIQUE

David Gates
Wildlife Biologist

	FACTOR	ASSIGNMENT OF IMPORTANCE VALUES									SUM	FACTOR WEIGHT
A	TERRESTRIAL HABITAT VALUE	1.5111									4.5	.300
B	WOODY EDGE	0	0.5.5 1								2	.133
C	AQUATIC HABITAT VALUE	.5	1	111							4.5	.300
D	SHORELINE DEVELOPMENT	0	.5	0	.51						2	.133
E	DREDGE SPOIL DISPOSAL	0	.5	0	.5	1					2	.133
F												
G												
H												
I												
J	(Dummy)	0	0	0	0	0					0	
										GRAND TOTAL	15	1.00

Procedure:

1. Compare Factor "A" with Factor "B." Assign a value of 1.0 to that factor perceived to be the more important and assign a value of 0.0 to the least important factor. If the two parameters are believed to have the same relative significance, assign a value of 0.5 to each.
2. Now compare Factor "A" with Factor "C", then "A" with "D" and so on down the list.
3. Then compare Factor "B" with all the other factors (don't compare "B" with Factor "A" - this has already been done).
4. Continue this comparative process with each of the remaining factors.
5. Determine totals for each factor and a grand total for all comparisons.
6. Divide the total score for a given factor by the grand total for that factor's weight.
7. State the major rationale used in assigning the relative importance values.

NOTE: The final comparison with a dummy factor assures that no real factor have a weight value of 0.0.

RATIONALE

The value of a particular land area for supporting plant and animal organisms is dependent upon its habitat. The habitat value parameters come the nearest to describing the general nature of the habitat at the various harbor site locations. Parameters of woody edge, shoreline development and dredging address the habitat in a much more specific way and are therefore considered to be of secondary importance to the habitat value parameters.

No justification could be found for considering the terrestrial habitat value as more or less important than the aquatic habitat value; these parameters are therefore considered to be of equal weight. Based on a similar rationale, the remaining three parameters were also considered to be of coequal weight.

BASED ON THE RANKED PAIRWISE COMPARISON TECHNIQUE

David [illegible]
Wildlife Biologist

	FACTOR	ASSIGNMENT OF IMPORTANCE VALUES										SUM	FACTOR WEIGHT
A	SAND/MUD FLATS	000101										2	.09
B	BRUSH LANDS	1	0.5101									3.5	.17
C	BOTTOMLAND FORESTS	1	1	11.51								5.5	.26
D	AGRICULTURAL LANDS	1	.5	0	101							3.5	.17
E	DEVELOPED LANDS	0	0	0	0	01						1	.05
F	WETLANDS	1	1	5	1	1	1					5.5	.26
G													
H													
I													
J	(Dummy)	0	0	0	0	0	0					0	.00
							GRAND TOTAL						1.00

Procedure:

1. Compare Factor "A" with Factor "B." Assign a value of 1.0 to that factor perceived to be the more important and assign a value of 0.0 to the least important factor. If the two parameters are believed to have the same relative significance, assign a value of 0.5 to each.
2. Now compare Factor "A" with Factor "C", then "A" with "D" and so on down the list.
3. Then compare Factor "B" with all the other factors (don't compare "B" with Factor "A" - this has already been done).
4. Continue this comparative process with each of the remaining factors.
5. Determine totals for each factor and a grand total for all comparisons.
6. Divide the total score for a given factor by the grand total for all comparisons.
7. State the major rationale used in assigning the relative importance values.

NOTE: The final comparison with a dummy factor assures that no real factor has a weight value of 0.0.

RATIONALE

The rationale used in the assignment of the terrestrial habitat weights was based on data extrapolated from two sources: (1) net primary production and (2) species numbers. The numerical values and the relative importance of habitats based on this extrapolated data is provided below:

	Data		***Relative Importance	
Habitat Type	*Net Productivity Per Unit Area (dry $g/m^2/yr$)	**Species Numbers	Net Productivity	Species Numbers
Sand and mud flats	350	29	0.07	0.10
Brush lands	600	52	0.12	0.18
Bottomland forests	1,300	89	0.26	0.31
Agricultural lands	650	54	0.13	0.19
Developed lands	10	6	0.00	0.02
Wetlands	2,000	59	0.42	0.20
TOTALS	4,910	289	1.00	1.00

* Source of data: Whittaker, R. H., 1970, "Communities and Ecosystems," the MacMillan Co., Collier-MacMillan Limited, London.

** Source of data:

Terpening, T.A., L. J. Hunt, D. K. Evans, S. J. Bleiweiss and R. C. Zoanetti, 1974. A survey of the fauna and flora occurring in the Mississippi River floodplain between St. Louis, Missouri, and Cairo, Illinois. Prepared for U.S. Army Engineer District, St. Louis, Contract No. DACW39-78-C-0042. 391 P.

*** Relative Importance = Individual habitat value divided by total for all habitat values

ASSIGNMENT OF AQUATIC HABITAT ANALYSIS FACTOR WEIGHTS
BASED ON THE RANKED PAIRWISE COMPARISON TECHNIQUE

Tom Keevin
Fisheries Biologist

	FACTOR	ASSIGNMENT OF IMPORTANCE VALUES						SUM	FACTOR WEIGHT
A	MAIN CHANNEL	0,0,0,0,0,1						1	0.05
B	MAIN CHANNEL BORDER	1	.5,.5,.5,.5,1					4	0.19
C	BACKWATERS	1	.5	.5,.5,1,1				4.5	0.21
D	LAKES AND PONDS	1	.5	.5	0,1,1			4	0.19
E	TRIBUTARIES	1	.5	.5	1	11		5	0.24
F	TAILWATERS	1	.5	0	0	0	1	2.5	0.12
G									
H									
I									
-	(Dummy)	0	0	0	0	0	0		
							GRAND TOTAL		1.00

Procedure:

1. Compare Factor "A" with Factor "B." Assign a value of 1.0 to that factor perceived to be the more important and assign a value of 0.0 to the least important factor. If the two parameters are believed to have the same relative significance, assign a value of 0.5 to each.
2. Now compare Factor "A" with Factor "C", then "A" with "D" and so on down the list.
3. Then compare Factor "B" with all the other factors (don't compare "B" with Factor "A" - this has already been done).
4. Continue this comparative process with each of the remaining factors.
5. Determine totals for each factor and a grand total for all comparisons.
6. Divide the total score for a given factor by the grand total for that factor's weight.
7. State the major rationale used in assigning the relative importance values.

NOTE: The final comparison with a dummy factor assures that no real factor has a weight value of 0.0.

Tributaries:	Contain all of the habitat in the other categories except Big River habitat which does support a distinctive assemblage of species.
Backwaters:	Important nursery area, cover, spawning, relative high productivity.
Main Channel Border:	Important spawning area, nursery and probably more diverse than main channel.
Lakes & Ponds:	Lower species diversity than above groups but relatively high productivity.
Tailwaters:	Limited artificial high quality habitat.
Main Channel:	Low diversity of species adapted to Big River habitat and species with wide ecological tolerance.

ASSIGNMENT OF TERRESTRIAL HABITAT ANALYSIS FACTOR WEIGHTS
BASED ON THE RANKED PAIRWISE COMPARISON TECHNIQUE

John Grady
Wildlife Biologist

	FACTOR	ASSIGNMENT OF IMPORTANCE VALUES						SUM	FACTOR WEIGHT
A	SAND/MUD FLATS	001101						3	.14
B	BRUSH LANDS	1	01101					4	.19
C	BOTTOMLAND FORESTS	1	1	1101				5	.24
D	AGRICULTURAL LANDS	0	0	0	101			2	.09
E	DEVELOPED LANDS	0	0	0	0	01		1	.05
F	WETLANDS	1	1	1	1	1	1	6	.29
G									
H									
I									
J	(Dummy)	0	0	0	0	0	0	21	
							GRAND TOTAL		1.00

Procedure:

1. Compare Factor "A" with Factor "B." Assign a value of 1.0 to that factor perceived to be the more important and assign a value of 0.0 to the least important factor. If the two parameters are believed to have the same relative significance, assign a value of 0.5 to each.
2. Now compare Factor "A" with Factor "C", then "A" with "D" and so on down the list.
3. Then compare Factor "B" with all the other factors (don't compare "B" with Factor "A" - this has already been done).
4. Continue this comparative process with each of the remaining factors.
5. Determine totals for each factor and a grand total for all comparisons.
6. Divide the total score for a given factor by the grand total for all comparisons.
7. State the major rationale used in assigning the relative importance values.

NOTE: The final comparison with a dummy factor assures that no real factor has a weight value of 0.0.

RATIONALE

No specific rationale was provided; this weighting reflects the subjective judgment of the participating biologist.

The two sets of weights provided for the terrestrial habitat analysis have been averaged to obtain the District's overall rating for this analysis. These values are given below:

Sand and mud flats	0.12
Brush lands	0.18
Bottomland forests	0.25
Agricultual lands	0.13
Developed lands	0.05
Wetlands	0.27

United States Department of the Interior

FISH AND WILDLIFE SERVICE

IN REPLY REFER TO:

ROCK ISLAND FIELD OFFICE (ES)
1830 SECOND AVENUE
ROCK ISLAND, ILLINOIS 61201

Com: 309-788-3991/3925
FTS: 360-9217/9274

July 24, 1980

Mr. Carey W. Burch
Environmental Planner
Versar, Inc.
6621 Electronic Drive
Springfield, Virginia 22151

Dear Mr. Burch:

Attached are the results of the pair-wise comparisons for terrestrial, aquatic and general habitats for the St. Louis Harbor Study. Basically the importance values were assigned after considering the habitats potential for supporting high species diversity as well as the regional importance a particular habitat may have along this portion of the river. In addition, we considered the federal rules and regulations that direct the Fish and Wildlife Service to protect certain types of habitat because of their significant value for fish and wildlife.

Note that we compared habitats twice as a way of double checking ourselves. Since both the sums and totals are doubled, the factor weights are not affected.

In completing the third phase of this evaluation, we find that the habitat type "woody edge" is not defined. We considered this habitat to consist of ecotone occurring at the interphase between forests, hedgerows and small woodlots, and all other forms of habitat (ie. old field, cropland, wetland, etc.). Because the term "edge" may be interpreted differently between trained fish and wildlife biologists and the analysis is being conducted by persons not necessarily trained in these disciplines, the type should be clearly defined.

This analysis applies only for the Mississippi River in the reach being considered for further development in the St. Louis Harbor Study. Application of these conclusions for any other purpose may not be valid.

Sincerely yours,

Thomas M. Groutage

Thomas M. Groutage
Field Supervisor

Rationale for Factor Weight Assignment - Terrestrial Habitat

Wetlands - Wetlands received the highest factor weight, a value of 0.26. Wetlands usually support a rich assortment of emergent and submergent vegetation which in turn provide food and cover for many species of fish and wildlife. Some wetlands are vital to certain fish spawning activities as well as pair formation, nesting and brooding of waterfowl Wetlands serve valuable water quality functions such as trapping sediments, filtering nutrients and protecting shorelines from erosion. The ability of wetlands to store high water is a natural form of flood control. It is estimated that approximately 300,000 acres of wetlands are drained or filled in the U.S. each year. The Fish and Wildlife Service places a high priority on wetland protection.

Bottomland Forests - Bottomland forests were rated 0.24. This habitat can provide some spawning and feeding for certain fish species when inundated. Dead and dying trees of sufficient size provide nests and dens for birds and mammals requiring cavities. Mast producing trees have greater food value for several bird and mammal species and all tree species provide nesting, feeding and perching sites for a wide variety of wildlife. A lot of bottomland forest has been cleared and converted to agricultural pursuits thereby increasing the value of the relict habitats remaining. All federal agencies are directed by an Executive Order to protect floodplains, including floodplain forest.

Brush - In this particular reach of the Mississippi River, we rated brush at 0.21. This causes the type to rank somewhat lower than usual. The lower value results primarily from the fact that the habitat is somewhat less diverse than bottomland forests (a condition which is usually reversed). Some of the brush species present provide browse for deer and those along the shore can supply brood cover for waterfowl.

Agricultural Lands - Agricultural lands were rated at 0.12 because intensively cultivated land has little or no wildlife value. Also, the disturbance through planting, cultivating, harvesting and plowing may not allow wildlife to become established in these areas. On the positive side, seasonally flooded grain fields can attract waterfowl and the presence of shelterbelts and fencerows may provide food and cover for some species. Some pasture and old fields may support rodent populations used by raptors.

Sand/Mud Flats - These too were rated at 0.12 because the sparse vegetation provides little cover. However, these sand and

Rationale for Factor Weight Assignment
Terrestrial Habitat (cont.)

mud flats provide good habitat for shore birds and when inundated may be used by some fish species for spawning and feeding.

Developed Land - This habitat received a 0.05 rating because there is little or no food or cover and these areas are highly disturbed by human activity.

ASSIGNMENT OF TERRESTRIAL HABITAT ANALYSIS FACTOR WEIGHTS

BASED ON THE RANKED PAIRWISE COMPARISON TECHNIQUE

FACTOR	ASSIGNMENT OF IMPORTANCE VALUES									SUM	FACTOR WEIGHT
	A	B	C	D	E	F	J				
A SAND/MUD FLATS		0.0	0.0	0.5	1.0	0.0	1.0			2.5	0.12
B BRUSH LANDS	1.0		0.5	1.0	1.0	0.0	1.0			4.5	0.21
C BOTTOMLAND FORESTS	1.0	0.5		1.0	1.0	0.5	1.0			5.0	0.24
D AGRICULTURAL LANDS	0.5	0.0	0.0		1.0	0.0	1.0			2.5	0.12
E DEVELOPED LANDS	0.0	0.0	0.0	0.0		0.0	1.0			1.0	0.05
F WETLANDS	1.0	1.0	0.5	1.0	1.0		1.0			5.5	0.26
G											
H											
I											
J (Dummy)	0.0	0.0	0.0	0.0	0.0	0.0				0.0	0.00
									GRAND TOTAL	21.0	1.00

Procedure:

1. Compare Factor "A" with Factor "B." Assign a value of 1.0 to that factor perceived to be the more important and assign a value of 0.0 to the least important factor. If the two parameters are believed to have the same relative significance, assign a value of 0.5 to each.
2. Now compare Factor "A" with Factor "C", then "A" with "D" and so on down the list.
3. Then compare Factor "B" with all the other factors (don't compare "B" with Factor "A" - this has already been done).
4. Continue this comparative process with each of the remaining factors.
5. Determine totals for each factor and a grand total for all comparisons.
6. Divide the total score for a given factor by the grand total for that factor's weight.
7. State the major rationale used in assigning the relative importance values.

NOTE: The final comparison with a dummy factor assures that no real factor have a weight value of 0.0.

Rationale for Factor Weight Assignment - General Habitat

Woody Edge - Rated at 0.30 because, as the name implies, these are areas where the edge effect of merging habitat types support a great diversity of species. These areas are particularly important to species requiring several habitat types to satisfy their life requirements. In addition, woody edge may provide travel lanes for the daily movements of several mammals.

Aquatic Habitat - Received a 0.27 due to high biological productivity associated with aquatic systems. Good water quality is essential for aquatic life as well as several recreational uses. This habitat supports fish, mussels, some furbearers, waterfowl and other birds.

Terrestrial Habitat - Rated at 0.23 because it includes a great variety of habitats supporting diverse plant and animal communities. In addition to the specific values listed for the terrestrial habitats there are many recreational activities to include.

Dredge Spoil Disposal - We rated this at 0.13 because spoil disposal displaces natural habitats and may be a source of erosion. On the positive side, the creation of islands may support food and cover vegetation beneficial to some forms of wildlife.

Shoreline Development - Only received a 0.07 because these areas are highly disturbed and provide little or no cover for wildlife. Many of these areas may be degraded by industrial or other commercial pollution.

ASSIGNMENT OF GENERAL HABITAT ANALYSIS FACTOR WEIGHTS

BASED ON THE RANKED PAIRWISE COMPARISON TECHNIQUE

	FACTOR	A	B	C	D	E	F				SUM	FACTOR WEIGHT
		ASSIGNMENT OF IMPORTANCE VALUES										
A	TERRESTRIAL HABITAT VALUE		0.0	0.5	1.0	1.0	1.0				3.5	0.23
B	WOODY EDGE	1.0		0.5	1.0	1.0	1.0				4.5	0.30
C	AQUATIC HABITAT VALUE	0.5	0.5		1.0	1.0	1.0				4.0	0.27
D	SHORELINE DEVELOPMENT	0.0	0.0	0.0		0.0	1.0				1.0	0.07
E	DREDGE SPOIL DISPOSAL	0.0	0.0	0.0	1.0		1.0				2.0	0.13
F												
G												
H												
I												
J	(Dummy)	0.0	0.0	0.0	0.0	0.0					0.0	0.00
							GRAND TOTAL					1.00

Procedure:

1. Compare Factor "A" with Factor "B." Assign a value of 1.0 to that factor perceived to be the more important and assign a value of 0.0 to the least important factor. If the two parameters are believed to have the same relative significance, assign a value of 0.5 to each.
2. Now compare Factor "A" with Factor "C", then "A" with "D" and so on down the list.
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4. Continue this comparative process with each of the remaining factors.
5. Determine totals for each factor and a grand total for all comparisons.
6. Divide the total score for a given factor by the grand total for that factor's weight.
7. State the major rationale used in assigning the relative importance values.

NOTE: The final comparison with a dummy factor assures that no real factor has a weight value of 0.0.

Rationale for Factor Weight Assignment - Aquatic Habitat

Backwaters - Backwaters were rated at 0.26 due to the wide range of aquatic systems included. Vegetation diversity is usually very high and backwaters provide the life requisites for many commercial and sport fish species. In addition, these waters serve as valuable breeding and feeding areas for waterfowl and furbearers.

Tributaries - We rated tributaries at 0.26 because each contains its own backwaters, main channel and channel border. The potential for fish and wildlife diversity is high due to the variety of habitats each contains. Also, many tributaries have higher water quality and support a more desirable fishery than found in the main stream.

Tailwaters - Received a rating of 0.17 although these areas may be disturbed, they do provide a good fishery and may function as feeding grounds for eagles during certain periods of the year.

Main Channel Border - Rated 0.17, main channel borders provide a variety of cover, food and general habitat for a diversity of species. Spawning and feeding activity by fish occurs here and the shallower areas may be used by wading birds and waterfowl. This is also the primary habitat for mussels including several threatened and endangered species.

Lakes/Ponds - We rated these waters at 0.10. Since they are not ususally connected to the river, they may have a different water quality and fishery. By including Type 5 wetlands in this category, the values for fish, waterfowl and furbearers must also be considered.

Main Channel - Rated at 0.05, some habitat for fish feeding and spawning and limited use by some waterfowl and other birds. Major drawbacks are the swift current and turbulence caused by commercial navigation.

ASSIGNMENT OF AQUATIC HABITAT ANALYSIS FACTOR WEIGHTS

BASED ON THE RANKED PAIRWISE COMPARISON TECHNIQUE

	FACTOR	A	B	C	D	E	F	J	SUM	FACTOR WEIGHT
		ASSIGNMENT OF IMPORTANCE VALUES								
A	MAIN CHANNEL		0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.05
B	MAIN CHANNEL BORDER	1.0		0.0	1.0	0.0	0.5	1.0	3.5	0.17
C	BACK WATERS	1.0	1.0		1.0	0.5	1.0	1.0	5.5	0.26
D	LAKES & PONDS	1.0	0.0	0.0		0.0	0.0	1.0	2.0	0.10
E	TRIBUTARIES	1.0	1.0	0.5	1.0		1.0	1.0	5.5	0.26
F	TAIL-WATERS	1.0	0.5	0.0	1.0	0.0		1.0	3.5	0.17
G										
H										
I										
J	(Dummy)	0.0	0.0	0.0	0.0	0.0			0.0	0.00
								GRAND TOTAL.	21.0	1.00

Procedure:

1. Compare Factor "A" with Factor "B." Assign a value of 1.0 to that factor perceived to be the more important and assign a value of 0.0 to the least important factor. If the two parameters are believed to have the same relative significance, assign a value of 0.5 to each.
2. Now compare Factor "A" with Factor "C", then "A" with "D" and so on down the list.
3. Then compare Factor "B" with all the other factors (don't compare "B" with Factor "A" - this has already been done).
4. Continue this comparative process with each of the remaining factors.
5. Determine totals for each factor and a grand total for all comparisons.
6. Divide the total score for a given factor by the grand total for that factor's weight.
7. State the major rationale used in assigning the relative importance values.

NOTE: The final comparison with a dummy factor assures that no real factor has a weight value of 0.0.

MISSOURI DEPARTMENT OF CONSERVATION

MAILING ADDRESS:
P.O. Box 180
Jefferson City, Missouri 65102

STREET LOCATION:
2901 North Ten Mile Drive
Jefferson City, Missouri 65101

Telephone 314-751-4115
LARRY R. GALE, Director

July 16, 1980

Mr. Carey W. Burch
Environmental Planning Division
Versar, Inc.
6621 Electronic Drive
Springfield, Virginia 22151

Dear Mr. Burch: Re: St. Louis Harbor Study

As per our meeting on July 1, 1980, enclosed please find the completed matrices for computing factor weights for use in the referenced study. As stated in the March 4, 1980 letter from Larry Gale to Colonel Dacey, we believe this procedure is satisfactory for a cursory biological evaluation of the 29 potential harbor sites within the St. Louis Harbor. Additional studies may be necessary to complete the EQ account required by Principles and Standards for those sites deemed most suitable for development.

We appreciate the opportunity to work with you on this effort. Please do not hesitate to contact me should you have any questions or comments.

Sincerely,

Norman Stucky

NORMAN P. STUCKY
ENVIRONMENTAL COORDINATOR

NPS:jct
Enc.

ASSIGNMENT OF TERRESTRIAL HABITAT ANALYSIS FACTOR WEIGHTS

BASED ON THE RANKED PAIRWISE COMPARISON TECHNIQUE

	FACTOR	ASSIGNMENT OF IMPORTANCE VALUES								SUM	FACTOR WEIGHT
		A	B	C	D	E	F	J			
A	SAND/MUD FLATS	—	0	0	.5	1	0	1		2.5	.10
B	BRUSH LANDS	1	—	0	0	1	0	1		3.0	.14
C	BOTTOMLAND FORESTS	1	1	—	.75	1	.25	1		5.0	.24
D	AGRICULTURAL LANDS	.5	1	.25	—	1	.25	1		4.0	.19
E	DEVELOPED LANDS	0	0	0	0	—	0	1		1.0	.05
F	WETLANDS	1	1	.75	.75	1	—	1		5.5	.26
G											
H											
I											
J	(Dummy)										
									GRAND TOTAL		1.00

Procedure:

1. Compare Factor "A" with Factor "B." Assign a value of 1.0 to that factor perceived to be the more important and assign a value of 0.0 to the least important factor. If the two parameters are believed to have the same relative significance, assign a value of 0.5 to each.
2. Now compare Factor "A" with Factor "C", then "A" with "D" and so on down the list.
3. Then compare Factor "B" with all the other factors (don't compare "B" with Factor "A" - this has already been done).
4. Continue this comparative process with each of the remaining factors.
5. Determine totals for each factor and a grand total for all comparisons.
6. Divide the total score for a given factor by the grand total for that factor's weight.
7. State the major rationale used in assigning the relative importance values.

NOTE: The final comparison with a dummy factor assures that no real factor have a weight value of 0.0.

ASSIGNMENT OF AQUATIC HABITAT ANALYSIS FACTOR WEIGHTS

BASED ON THE RANKED PAIRWISE COMPARISON TECHNIQUE

	FACTOR	A	B	C	D	E	F	J			SUM	FACTOR WEIGHT
		ASSIGNMENT OF IMPORTANCE VALUES										
A	MAIN CHANNEL	—	0	0	0	0	0	1			1	.05
B	MAIN CHANNEL BORDER	1	—	0	.25	.25	.25	1			2.75	.13
C	BACK WATERS	1	1	—	.75	.75	.75	1			5.25	.25
D	LAKES & PONDS	1	.75	.25	—	.25	.25	1			3.5	.17
E	TRIBUTARIES	1	.75	.25	.75	—	.75	1			4.5	.21
F	TAIL-WATERS	1	.75	.25	.75	.25	—	1			4	.19
G												
H												
I												
J	(Dummy)											
										GRAND TOTAL		1.00

Procedure:

1. Compare Factor "A" with Factor "B." Assign a value of 1.0 to that factor perceived to be the more important and assign a value of 0.0 to the least important factor. If the two parameters are believed to have the same relative significance, assign a value of 0.5 to each.
2. Now compare Factor "A" with Factor "C", then "A" with "D" and so on down the list.
3. Then compare Factor "B" with all the other factors (don't compare "B" with Factor "A" - this has already been done).
4. Continue this comparative process with each of the remaining factors.
5. Determine totals for each factor and a grand total for all comparisons.
6. Divide the total score for a given factor by the grand total for that factor's weight.
7. State the major rationale used in assigning the relative importance values.

NOTE: The final comparison with a dummy factor assures that no real factor has a weight value of 0.0.

ASSIGNMENT OF GENERAL HABITAT ANALYSIS FACTOR WEIGHTS

BASED ON THE RANKED PAIRWISE COMPARISON TECHNIQUE

	FACTOR	A	B	C	D	E	J			SUM	FACTOR WEIGHT
		ASSIGNMENT OF IMPORTANCE VALUES									
A	TERRESTRIAL HABITAT VALUE	—	.5	.5	1	1	1			4.0	.27
B	WOODY EDGE	.5	—	.5	1	1	1			4.0	.27
C	AQUATIC HABITAT VALUE	.5	.5	—	1	1	1			4.0	.27
D	SHORELINE DEVELOPMENT	0	0	0	—	0	1			1.0	.07
E	DREDGE SPOIL DISPOSAL	0	0	0	1	—	1			2.0	.13
F											
G											
H											
I											
J	(Dummy)										
							GRAND TOTAL			15	1.00

Procedure:

1. Compare Factor "A" with Factor "B." Assign a value of 1.0 to that factor perceived to be the more important and assign a value of 0.0 to the least important factor. If the two parameters are believed to have the same relative significance, assign a value of 0.5 to each.
2. Now compare Factor "A" with Factor "C", then "A" with "D" and so on down the list.
3. Then compare Factor "B" with all the other factors (don't compare "B" with Factor "A" - this has already been done).
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5. Determine totals for each factor and a grand total for all comparisons.
6. Divide the total score for a given factor by the grand total for that factor's weight.
7. State the major rationale used in assigning the relative importance values.

NOTE: The final comparison with a dummy factor assures that no real factor has a weight value of 0.0.

Illinois Department of Conservation
life and land together

605 WM. G. STRATTON BUILDING • 400 SOUTH SPRING STREET • SPRINGFIELD 62706
CHICAGO OFFICE – ROOM 100, 160 NO. LASALLE 60601
David Kenney, Director • James C. Helfrich, Assistant Director

July 17, 1980

Mr. Carey W. Burch
Environmental Planning Division
Versar, Inc.
6621 Electronic Drive
Springfield, VA 22151

Dear Mr. Burch:

Attached for your information is our input to the habitat weighting system for the St. Louis Harbor Study. Though we had some slight difficulty with the ranking forms, I believe the relative values are properly indicated. Please contact me if you need any further information at this time.

Sincerely,

Robert W. Schanzle
Permit Program Manager
Division of Planning

RWS:gm
Attachment

cc: David Gates (St. Louis District, Corps of Engineers)

AQUATIC HABITAT ANALYSIS WEIGHTING

Main Channel - While main channel areas are used by fish and other aquatic life to some extent, they do not generally support spawning or nursery areas, mussel beds, etc., and they are subject to disturbance by river traffic. Thus, such areas are considered of lower value than most other aquatic types.

Main Channel Border - These areas are very important as habitat for most types of fish and benthos, and they are the most productive areas within the river proper. They are rated equal to or higher than the other aquatic types.

Backwaters - The definition of backwaters includes chutes, side channels, etc., which have been shown to be of major importance to the overall productivity of the river system. Thus, these areas are also weighted equal to or higher than the other aquatic types.

Lakes and Ponds - These areas are of importance to many types of fish and wildlife, and they are manageable as recreational resources. However, they are considered of lesser importance to the riverine system and its productivity because of their isolation from it. Thus, they are rated somewhat lower than the more productive areas such as main channel border, backwaters and tributaries.

Tributaries - Tributaries may be important as spawning and nursery areas, in nutrient input to the river system, and as sources of forage fishes. They are thus rated highly.

Tailwaters - While tailwaters are productive areas for fish, they are by definition related to artificial disturbances to the river (dams). Thus, they are not rated as highly as most "natural" aquatic types.

TERRESTRIAL HABITAT ANALYSIS WEIGHTING

Sand/Mud Flats - While these sites do have value to shorebirds and some other forms of wildlife, they are not particularly diverse. They are also fairly common in the study area and elsewhere. Thus, they receive a lower rating than everything except for developed and agricultural lands.

Brush Lands - Since these areas are defined as early successional sites dominated by willow and cottonwood, they are rated relatively low. Such sites lack the diversity

TERRESTRIAL HABITAT ANALYSIS WEIGHTING (cont.)

Brush Lands (cont.) - and food production value that would make them attractive to many wildlife species. It would have been helpful for weighting purposes to have a category for old field brushlands. These may be very important to many forms of wildlife.

Bottomland Forests - This category includes sites that are more diverse than brush lands and which may include mast producing and den trees. Of the terrestrial types, they are considered the most important.

Agricultural Land - These sites have only marginal value as habitat, though they may provide some wildlife food. They are considered of lesser value than any type besides developed land.

Developed Land - These sites are considered to have essentially no habitat value.

Wetlands - Wetlands are among the most diverse of wildlife habitats and are thus rated highly. For puposes of this study, only a truly high quality bottomland forest is considered of higher value.

GENERAL HABITAT ANALYSIS RATING

Of the five habitat types evaluated, terrestrial, woody edge and aquatic were considered to be of approximately equal value. However, each type is of importance to different species; thus, an objective relative weighting is difficult to provide.

Dredge spoil disposal and shoreline development were rated low because of their lack of habitat value. However, when compared to each other, dredge spoil disposal receives a higher rating because of its potential for use by shorebirds.

ASSIGNMENT OF TERRESTRIAL HABITAT ANALYSIS FACTOR WEIGHTS

BASED ON THE RANKED PAIRWISE COMPARISON TECHNIQUE

FACTOR	ASSIGNMENT OF IMPORTANCE VALUES								SUM	FACTOR WEIGHT
A SAND/MUD FLATS	—	.75	1.0	.5	0	1.0	0			
B BRUSH LANDS	.25	—	1.0	.75	0	1.0	0			
C NONWETLAND FORESTS	0	.0	—	0	0	.4	0			
D AGRICULTURAL LANDS	.5	.75	1.0	—	0	1.0	0			
E DEVELOPED LANDS	1.0	1.0	1.0	1.0	—	1.0	1			
F WETLANDS	.0	0	.6	0	0	—	.5			
G Dummy	1.0	1.0	1.0	1.0	1.0	1.0	—			
I										
J Sum	2.75	3.50	5.60	3.75	1.00	5.40	0		21.0	
K Factor Weight (Dummy)	.131	.167	.267	.131	.048	.257			1.00	
								GRAND TOTAL		1.00

Procedure:

1. Compare Factor "A" with Factor "B." Assign a value of 1.0 to that factor perceived to be the more important and assign a value of 0.0 to the least important factor. If the two parameters are believed to have the same relative significance, assign a value of 0.5 to each.
2. Now compare Factor "A" with Factor "C", then "A" with "D" and so on down the list.
3. Then compare Factor "B" with all the other factors (don't compare "B" with Factor "A" - this has already been done).
4. Continue this comparative process with each of the remaining factors.
5. Determine totals for each factor and a grand total for all comparisons.
6. Divide the total score for a given factor by the grand total for all comparisons.
7. State the major rationale used in assigning the relative importance values.

NOTE: The final comparison with a dummy factor assures that no real factor has a weight value of 0.0.

ASSIGNMENT OF AQUATIC HABITAT ANALYSIS FACTOR WEIGHTS

BASED ON THE RANKED PAIRWISE COMPARISON TECHNIQUE

	FACTOR	ASSIGNMENT OF IMPORTANCE VALUES									SUM	FACTOR WEIGHT
A	MAIN CHANNEL	—	1.0	1.0	1.0	1.0	.75	0				
B	MAIN CHANNEL BORDER	0	—	.5	.25	.5	.25	0				
C	BACKWATERS	0	.5	—	.25	.5	.25	0				
D	LAKES AND PONDS	0	.75	.75	—	.75	.25	0				
E	TRIBUTARIES	0	.5	.5	.25	—	.25	0				
F	TAILWATERS	.25	.75	.75	.75	.75	—	0				
G	Dummy	1.0	1.0	1.0	1.0	1.0	1.0	—				
H												
I	Sum	1.25	4.50	4.50	3.50	4.50	2.75				21.0	
J	Factor Weight (Dummy)	.059	.214	.214	.166	.214	.131				1.00	
							GRAND TOTAL					~~1.00~~

Procedure:

1. Compare Factor "A" with Factor "B." Assign a value of 1.0 to that factor perceived to be the more important and assign a value of 0.0 to the least important factor. If the two parameters are believed to have the same relative significance, assign a value of 0.5 to each.
2. Now compare Factor "A" with Factor "C", then "A" with "D" and so on down the list.
3. Then compare Factor "B" with all the other factors (don't compare "B" with Factor "A" - this has already been done).
4. Continue this comparative process with each of the remaining factors.
5. Determine totals for each factor and a grand total for all comparisons.
6. Divide the total score for a given factor by the grand total for all comparisons.
7. State the major rationale used in assigning the relative importance values.

NOTE: The final comparison with a dummy factor assures that no real factor has a weight value of 0.0.

ASSIGNMENT OF GENERAL HABITAT ANALYSIS FACTOR WEIGHTS

BASED ON THE RANKED PAIRWISE COMPARISON TECHNIQUE

	FACTOR	ASSIGNMENT OF IMPORTANCE VALUES									SUM	FACTOR WEIGHT
A	TERRESTRIAL HABITAT VALUE	—	.5	.5	.0	.0	0					
B	WOODY EDGE	.5	—	.75	.0	.0	.0					
C	AQUATIC HABITAT VALUE	.5	.25	—	.0	.0	.0					
D	SHORELINE DEVELOPMENT	1.0	1.0	1.0	—	.75	0					
E	DREDGE SPOIL DISPOSAL	1.0	1.0	1.0	.25	—	.0					
F	Dummy	1.0	1.0	1.0	1.0	1.0	—					
G												
H												
I	Sum	4.00	3.75	4.25	1.25	1.75	0.00				15	
J	Factor Weight (Dummy)	.267	.250	.283	.083	.117					1.00	
										GRAND TOTAL		-1.00

Procedure:

1. Compare Factor "A" with Factor "B." Assign a value of 1.0 to that factor perceived to be the more important and assign a value of 0.0 to the least important factor. If the two parameters are believed to have the same relative significance, assign a value of 0.5 to each.
2. Now compare Factor "A" with Factor "C", then "A" with "D" and so on down the list.
3. Then compare Factor "B" with all the other factors (don't compare "B" with Factor "A" - this has already been done).
4. Continue this comparative process with each of the remaining factors.
5. Determine totals for each factor and a grand total for all comparisons.
6. Divide the total score for a given factor by the grand total for all comparisons.
7. State the major rationale used in assigning the relative importance values.

NOTE: The final comparison with a dummy factor assures that no real factor has a weight value of 0.0.

APPENDIX E

TERRESTRIAL AND AQUATIC HABITAT AREAS

Table E-1. TERRESTRIAL HABITAT AREAS (SQUARE METERS)

Site	Sand/Mud Flats	Brush Lands	Bottomland Forests	Agricultural Lands	Developed Lands	Wetlands	Total Terrestrial Area
1	17,280	0	1,016,640	19,261,440	187,200	0	20,482,560
2	31,680	23,040	889,920	1,097,280	141,120	0	2,183,040
3	629,280	524,160	3,160,800	11,350,080	967,680	95,040	16,727,040
4	72,000	48,960	167,040	0	285,120	0	573,120
5	204,480	293,760	1,575,360	8,251,200	440,640	14,400	10,779,840
6	0	0	2,076,480	1,195,200	668,160	0	3,939,840
7	0	0	1,667,520	708,480	216,000	0	2,592,000
8	0	0	570,240	12,113,280	308,160	0	12,991,680
9	385,920	51,840	1,811,520	6,981,120	469,440	34,560	9,734,400
10	0	0	31,680	0	181,440	0	213,120
11	0	0	797,760	13,075,200	2,255,040	0	16,128,000
12	0	0	0	0	725,760	0	725,760
13	480,960	0	2,877,120	7,041,600	2,638,080	25,920	13,063,680
14	290,880	28,800	1,765,440	3,787,200	1,465,920	0	7,338,240
15	0	0	51,840	0	3,081,600	0	3,133,440
16	43,200	0	66,240	0	3,314,880	0	3,424,320
17	43,200	0	69,120	1,059,840	5,880,960	0	7,053,120
18	28,800	0	397,440	0	6,125,760	0	6,552,000
19	28,800	0	311,040	0	2,914,560	0	3,254,400
20	0	54,720	0	0	2,384,640	0	2,439,360
21	0	106,560	0	0	2,465,280	48,960	2,620,800
22	0	313,920	92,160	0	8,107,200	34,560	8,547,840
23	0	0	1,673,280	8,614,080	2,658,240	0	12,945,600
24	0	0	613,440	6,517,440	2,543,040	0	9,673,920
25	0	164,160	218,880	5,607,360	0	31,680	6,022,080
26	40,320	774,720	1,500,480	14,978,880	83,520	564,480	17,942,400
27	97,920	198,720	2,318,400	7,701,120	112,320	97,920	10,526,400
28	0	282,240	840,960	2,180,160	10,500,480	0	13,803,840
29	0	0	849,600	3,568,320	336,960	1,209,600	5,964,480

Table E-2. AQUATIC HABITAT AREAS (SQUARE METERS)

Site	Main Channel	Main Channel Border	Backwaters	Lakes and Ponds	Tributaries	Tailwaters	Total Aquatic Area
1	2,370,240	1,356,480	0	0	0	0	3,726,720
2	1,730,880	1,149,120	0	92,160	28,800	0	3,000,960
3	1,834,560	1,103,040	0	60,480	118,080	0	3,116,160
4	1,722,240	1,422,720	0	0	57,600	0	3,205,440
5	1,563,840	1,523,520	34,560	28,800	112,320	0	3,263,040
6	1,958,400	1,344,960	0	0	172,800	0	3,476,160
7	2,174,400	1,744,080	0	0	106,560	0	4,055,040
8	1,455,760	1,929,600	0	5,760	0	0	3,381,120
9	1,488,960	1,491,840	184,320	120,960	0	0	3,286,080
10	1,673,280	1,540,800	80,640	0	0	0	3,294,720
11	1,797,120	1,851,840	0	63,360	51,840	0	3,764,160
12	1,647,360	1,215,360	0	0	51,840	0	2,914,560
13	1,477,440	1,154,880	0	51,840	69,120	0	2,753,280
14	1,575,360	1,621,440	0	40,320	0	0	3,237,120
15	1,638,720	1,298,880	0	0	0	0	2,937,600
16	1,681,920	1,903,680	0	0	0	0	3,585,600
17	1,140,480	1,249,920	0	0	0	0	2,390,400
18	892,800	1,676,160	0	0	0	0	2,568,960
19	1,108,800	1,926,720	0	0	0	0	3,035,520
20	627,840	3,029,760	0	0	0	0	3,657,600
21	708,480	2,476,800	0	0	8,640	0	3,193,920
22	2,093,760	5,932,800	0	46,080	11,520	653,760	8,737,920
23*	2,747,520	1,630,080	95,040	506,880	388,800	0	5,368,320
24*	1,710,720	0	0	184,320	0	0	1,895,040
25	1,284,480	2,494,080	66,240	0	0	0	3,844,800
26	1,408,320	3,954,240	86,400	0	0	0	5,448,960
27	1,733,760	1,195,200	616,320	69,120	43,200	0	3,657,600
28	1,961,280	1,336,320	334,080	161,280	100,800	0	3,893,760
29	1,831,680	2,108,160	54,720	112,320	0	576,000	4,682,880

*Chain of Rocks Canal

APPENDIX F

UNWEIGHTED RATING CALCULATIONS FOR WOODY EDGE, SHORELINE DEVELOPMENT, AND DREDGING

Table F-1. WOODY EDGE CALCULATIONS

Site	Length of Woody Edge (Meters)	Total Area of Terrestrial Habitat (Meters^2)	$\frac{\text{Woody Edge}}{\text{Terrestrial Habitat}}$
1	15,636	20,482,560	0.0008
2	12,588	2,183,040	0.006
3	45,195	16,727,040	0.003
4	3,658	573,120	0.006
5	19,812	10,779,840	0.002
6	24,933	3,939,840	0.006
7	18,745	2,592,000	0.007
8	17,654	12,991,680	0.001
9	26,304	9,734,400	0.003
10	878	213,120	0.004
11	13,381	16,128,000	0.001
12	0	725,760	0
13	31,224	13,063,680	0.002
14	24,933	7,338,240	0.003
15	1,030	3,133,440	0.0003
16	2,365	3,424,320	0.0007
17	1,719	7,053,120	0.0002
18	8,352	6,552,000	0.001
19	5,383	3,254,400	0.002
20	1,945	2,439,640	0.0008
21	3,780	2,620,800	0.001
22	13,112	8,547,840	0.002
23	22,957	12,945,600	0.002
24	9,534	9,673,920	0.001
25	7,937	6,022,080	0.001
26	30,315	17,942,400	0.002
27	30,018	10,526,400	0.003
28	26,579	13,803,840	0.002
29	11,430	5,964,480	0.002

Table F-2. SHORELINE DEVELOPMENT CALCULATIONS

Site	Length of Developed Shoreline (Meters)	Length of Total Shoreline (Meters^2)	Developed Shoreline / Total Shoreline
1	152	1,829	0.083
2	274	3,277	0.084
3	0	7,961	0
4	0	1,158	0
5	0	2,804	0
6	1,372	8,778	0.156
7	1,219	5,486	0.220
8	0	347	0
9	0	6,212	0
10	914	914	1.000
11	0	1,219	0
12	689	689	1.000
13	1,567	8,955	0.170
14	805	4,499	0.180
15	3,414	3,658	0.930
16	3,085	4,005	0.770
17	4,042	4,840	0.840
18	1,487	3,773	0.390
19	957	2,365	0.400
20	616	1,487	0.410
21	914	2,670	0.342
22	5,182	9,949	0.520
23	11,448	12,003	0.950
24	7,620	7,620	1.000
25	0	3,011	0
26	0	10,022	0
27	805	6,255	0.128
28	2,438	9,754	0.250
29	914	3,200	0.286

Table F-3. DREDGING CALCULATIONS -- VOLUME

Site	Total River Miles	Amount Dredged 1964-1973 (Cubic Yds.)	Amount Dredged 1973-1979 (Cubic Yds.)	Total (Cubic Yds.)	Total Cubic Yds. 15 Years	Total Cubic Yds. 15 Years / Mile
1	4.0	1,689,000	0	1,689,000	105,563	26,391
2	3.5	834,000	0	834,000	52,125	14,893
3	3.1	707,000	0	707,000	44,188	14,254
4	3.3	780,800	0	780,000	48,800	14,780
5	3.2	624,200	0	624,200	39,013	12,191
6	3.4	729,000	159,000	888,000	55,500	16,324
7	3.8	786,000	254,400	1,040,400	65,025	17,112
8	3.3	106,800	0	106,800	6,675	2,023
9	3.3	357,800	1,604,400	1,962,200	122,638	37,163
10	3.3	502,000	1,789,800	2,291,800	143,238	43,405
11	3.8	570,600	1,452,400	2,023,000	126,438	33,273
12	3.3	379,200	697,200	1,076,400	67,275	20,387
13	3.0	240,000	284,000	524,000	32,750	10,917
14	3.4	278,800	608,600	887,400	55,463	16,313
15	3.2	229,600	402,800	632,400	39,525	12,352
16	4.9	1,469,000	1,661,200	3,130,200	195,638	39,926
17	3.1	336,000	521,800	857,800	53,613	17,924
18	2.6	2,180,000	2,868,800	5,048,800	315,550	121,365
19	3.2	2,300,000	2,756,600	5,256,600	328,538	102,668
20	3.7	2,204,000	3,430,600	5,634,600	352,163	95,179
21	3.6	0	1,125,600	1,125,600	70,350	19,542
22	7.8	1,315,200	3,149,600	4,464,800	279,050	35,776
23	3.1	3,230,000	2,552,500	5,782,500	385,500	124,355
24 *	9.0					
25	3.1	736,400	236,800	973,200	60,825	19,621
26	4.3	892,000	288,400	1,180,400	73,775	17,157
27	3.5	0	0	0	0	0
28	4.5	28,000	0	28,000	1,750	389
29	3.2	39,200	344,000	383,200	23,950	7,484

*Chain of Rocks Canal

Table F-4. DREDGING CALCULATIONS -- FREQUENCY

Site	Total River Miles	Average* Dredging Frequency Per Mile, 1964-1979	Average Dredging Frequency Per Mile Per Year
1	4.0	4.95	0.33
2	3.5	1.86	0.12
3	3.1	4.03	0.27
4	3.3	4.12	0.27
5	3.2	4.34	0.29
6	3.4	6.00	0.40
7	3.8	5.53	0.37
8	3.3	1.00	0.07
9	3.3	9.30	0.62
10	3.3	11.64	0.78
11	3.8	8.00	0.53
12	3.3	6.12	0.41
13	3.0	2.00	0.13
14	3.4	3.50	0.23
15	3.2	4.63	0.31
16	4.9	9.41	0.63
17	3.1	6.58	0.44
18	2.6	23.08	1.54
19	3.2	22.81	1.52
20	3.7	21.57	1.44
21	3.6	4.72	0.31
22	7.8	7.31	0.49
23	3.1	10.23	0.68
24**	0.0	0.00	0.00
25	3.1	3.52	0.23
26	4.3	3.37	0.22
27	3.5	0.00	0.00
28	4.5	0.11	0.01
29	3.2	3.34	0.22

* Weighted Average
** Chain of Rocks Canal, dredging data not available

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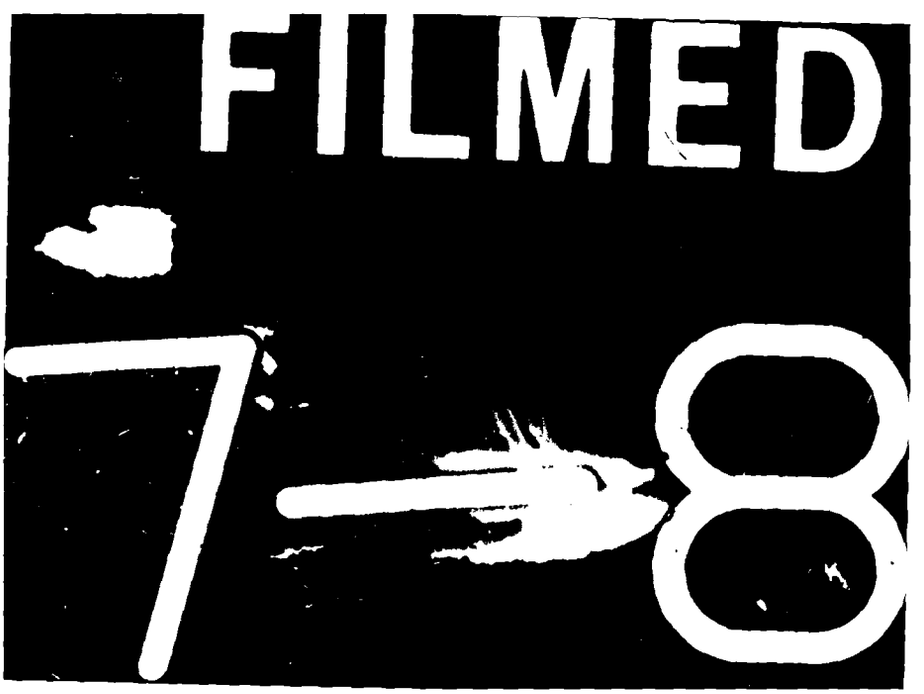
Table F-5. DREDGING CALCULATIONS -- DREDGING INDEX

Site	Dredging Frequency Per Mile Per Year (f_i)	$\frac{f_i}{f_{max}}$*	Total Cubic Yds Per Mile Per Year (V_i)	$\frac{V_i}{V_{max}}$**	Dredging Index (D)
1	0.33	0.21	26,391	0.21	0.42
2	0.12	0.08	14,893	0.12	0.20
3	0.27	0.18	14,254	0.12	0.30
4	0.27	0.18	14,780	0.12	0.30
5	0.29	0.19	12,191	0.10	0.29
6	0.40	0.26	16,324	0.13	0.39
7	0.37	0.24	17,112	0.14	0.38
8	0.07	0.05	2,023	0.02	0.07
9	0.62	0.40	37,163	0.30	0.70
10	0.78	0.51	43,405	0.35	0.86
11	0.53	0.34	33,273	0.27	0.61
12	0.41	0.27	20,387	0.16	0.43
13	0.13	0.08	10,917	0.09	0.17
14	0.23	0.15	16,313	0.13	0.28
15	0.31	0.20	12,352	0.10	0.30
16	0.63	0.41	39,926	0.32	0.73
17	0.44	0.29	17,924	0.14	0.43
18	1.54	1.00	121,365	0.98	1.98
19	1.52	0.99	102,668	0.83	1.82
20	1.44	0.94	95,179	0.77	1.71
21	0.31	0.20	19,542	0.16	0.36
22	0.49	0.32	35,776	0.29	0.61
23	0.68	0.44	124,355	1.00	1.44
24***	0.00	0.00	0	0.00	0.00
25	0.23	0.15	19,621	0.16	0.31
26	0.22	0.14	17,157	0.14	0.28
27	0.00	0.00	0	0.00	0.00
28	0.01	0.01	389	0.00	0.01
29	0.22	0.14	7,484	0.06	0.20

*f_{max} = 1.54 per mile per year; this value occurred at Site 18.

**V_{max} = 124,355 cu. yd. per mile per year; this value occurred at Site 23.

***Dredging data were not available for the Chain of Rocks Canal.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